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AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 14, No. 26. WEEKLY. | NEW YORK, THURSDAY, JUNE 25, 1891. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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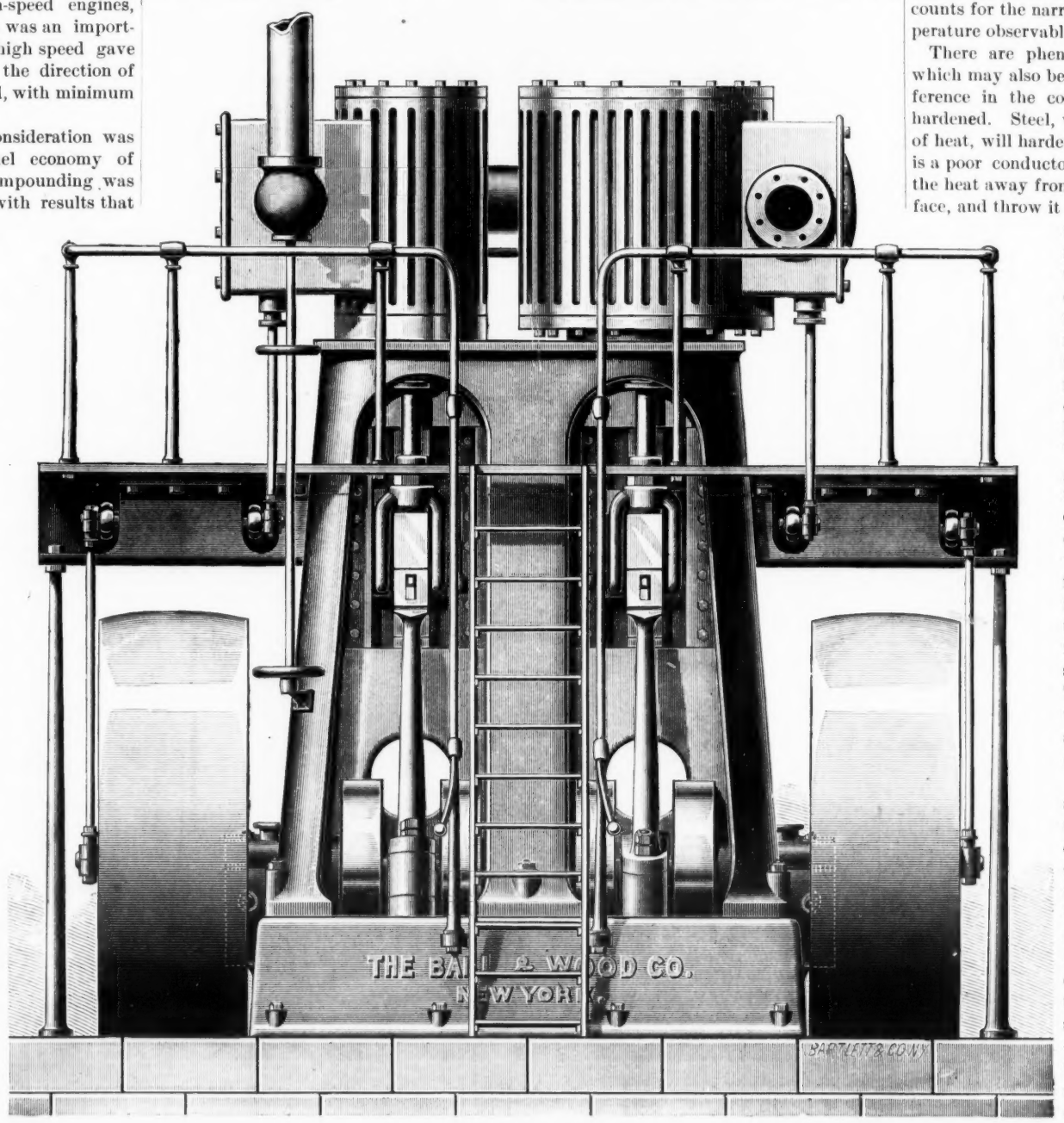
Five Hundred Horse-power High-speed Compound Engine.

An interesting feature of the modern application of electricity is the development of the high-speed engine, for which electricity is mainly responsible. The slow-speed engine was practically a perfected machine when electric dynamos for commercial purposes were first put into service, while the high-speed engine may be said to have developed simultaneously with the electric industry. The earlier dynamos were almost invariably driven by high-speed engines, mainly because compactness was an important consideration, and the high speed gave an opportunity to work in the direction of the close regulation required, with minimum weight and moderate cost.

A little later on more consideration was given to increasing the fuel economy of high-speed engines, and compounding was finally brought into play, with results that appear to be gratifying. In fact, the advocates of high speed assert that compounding is especially adapted to this class of engines, showing a greater gain in economy than in slow speed, whether both are operated with or without condensers. By the introduction of compounding, the field for high-speed engines has been materially broadened.

In Europe, high-speed vertical compound engines are quite extensively used, and it is believed by many that even for large power they will come into general favor here, particularly where floor space is valuable, as it is likely to be in the instance of electric light plants.

The cuts on this page and on page 2 show two views of a 500 horse-power engine of the class just referred to. The floor space required, including wheels, is about 8 feet by 12 feet, thus giving more than five horse-power for each square foot of floor space occupied. The height is about twelve feet above the floor. The cylinders are 20 and 34 inches diameter; stroke of pistons, 20 inches.



HIGH-SPEED COMPOUND ENGINE.

This engine is built by The Ball & Wood Company at their Elizabethport, N. J., shops, and has in its governor, valve, etc., the characteristic features of the Ball engines.

For convenience of access the front legs of the frame are arranged to be detached just below the gallery floor and removed entirely, thus allowing the shaft to be rolled out at the front of the engine.

The rest of the frame is cast in one piece, except the guides, which are placed on finished seats in the frame.

Both valves are driven from crank-pins, instead of eccentrics, one being part of the automatic cut-off governor, and the other set in a plate arranged for an adjustable cut-off.

The rock shafts are carried in adjustable boxes placed in a bracket, one end of which is attached to the frame, the other end being supported by a pillar set on the foundation. This bracket is placed under the gallery floor, and forms one of its supports at each side of the engine. A movable section of floor permits ready access to the rock shafts for inspection or oiling.

It is given out by the construction department of the World's Fair that 15,000 men will be employed on the buildings by July 4, and not less than twice that number a month later.

Just exactly where the length of the cylinder of a steam engine should be cut off to give the best results in steam consumption, has never been plainly determined. Then outside this there are other considerations that call for figures. Altogether, the subject is a complicated one.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

WELDING — CONDUCTIVITY — ITS EFFECTS UPON WELDING — UPON HARDENING — WELDING THIN STEEL—AIDS TO WELDING —POSITION OF SCARFS—BUTT WELDING— BAD PILING — SCYTHES — SCYTHE-MAKING MACHINERY.

Capacity for the conduction of heat may vary in different kinds of iron and steel to a very perceptible extent. Although there are exceptions to the rule that irons which are the worst conductors have the best welding properties, yet it is true that there is a larger range of welding heat in those kinds which are poor conductors because their surfaces may be made sufficiently hot to flux and show fluidity while the interior has still sufficient cohesion to retain its form.

The different capacities of irons for conducting heat may arise from the effect which variations in its intensity may have upon their constituents, and upon the relations which they successively sustain to each other, while their affinities are modified by changes of temperature. It is possible that carbon, when at a temperature below 1,200°, may retard the passage of heat, but that, when it becomes incandescent, it adds fuel to the flame and spurs it along. Once raised to the point of ignition, any accession of oxygen, from whatever source, would occasion combustion, and this, taking place in immediate contact with particles of iron, would lower the point at which coherence would be destroyed. This hypothesis accounts for the narrow range of welding temperature observable in irons high in carbon.

There are phenomena in hardening steel which may also be accounted for by the difference in the conductivity of the pieces hardened. Steel, which is a good conductor of heat, will harden deeper than that which is a poor conductor, because it will convey the heat away from the interior to the surface, and throw it off there into the cooling medium with greater rapidity, and fix more of the carbon in its diffused condition, combined with the iron ("set the diamonds"), before it has time to fly from it. In fact, steel which is a good conductor hardens deeper because it cools quicker. The addition of manganese does not appear to improve its conductivity, except by neutralizing less desirable elements. Steel, which is a good conductor, is not liable to crack. If it was a perfect conductor, the inside would cool as fast as the outside, and simultaneously with it. There would not then be unequal contraction, or anything of the kind, to cause cracks.

In dipping pieces of steel endwise into water to harden them up for a certain distance, but not as far as they are heated to redness, it is found to be expedient to keep the piece slightly in motion up and down, to avoid cracking by abrupt cessation of the cooling and shrinking at the surface of the water. The cooling effects of the water are less abruptly marked on steel in proportion as its capacity for conducting heat is increased; poor conductors suffer most from this cause. Greater care must, therefore, be taken to make the termination of the hardened portion less distinct, and if this condition is complied with, the tools made from such steel may be better than if made from a steel having greater capacity for deep hardening. Reamers and taps are familiar instances where deep hardening is unnecessary, while hammers, striking dies and other articles subject to percussion, it is generally allowed, should have a hard backing, to prevent indentation.

In heating iron for welding, the surfaces become fluid before the mass disintegrates. In bringing the pieces together which are to be welded, the fluids run into each other and coalesce. But these fluid surfaces are not simply melted iron. They are composed, in part, of something else, at the bottom of which is the iron itself in an adhesive condition. Whatever this fluxed slag may be—silica, or borax, or anything else—it must be expressed to permit the raw fibers of the iron beneath to grip and fasten upon each other. Each piece inserts its fibers among the others, as far as the condition of the substance will permit, and the deeper the fluidity of the surfaces descends, the greater will be the depth to which they will intermingle, and the more perfect will be the weld.

In what is sometimes called "cold welding," which is a process which is sometimes performed, and generally by accident, without either desire or design, the immediate contact required between particles, to insure their cohesion, is brought about by pressure and movement tending to expel everything from between the surfaces. As cold welding is the uniting of short bits of fiber tenaciously, so thin sheets of steel may be hot welded; but the thickness of the weld, the region where the fibers interlock, or are felted together, will extend but little distance on either side of the jointure. In most cases, thin sheets thus united, when subjected to a tearing strain, may be torn apart. When thus separated, they will generally show some bright places, which have an appearance as though the metal itself was torn asunder, and other places clean and white, which appear as though the two sheets had been in immediate contact, although the particles of one had not interpenetrated and felted with the particles of the other. If the surfaces are found to be discolored, it is evidence that they had been separated by the film of oxide thus disclosed.

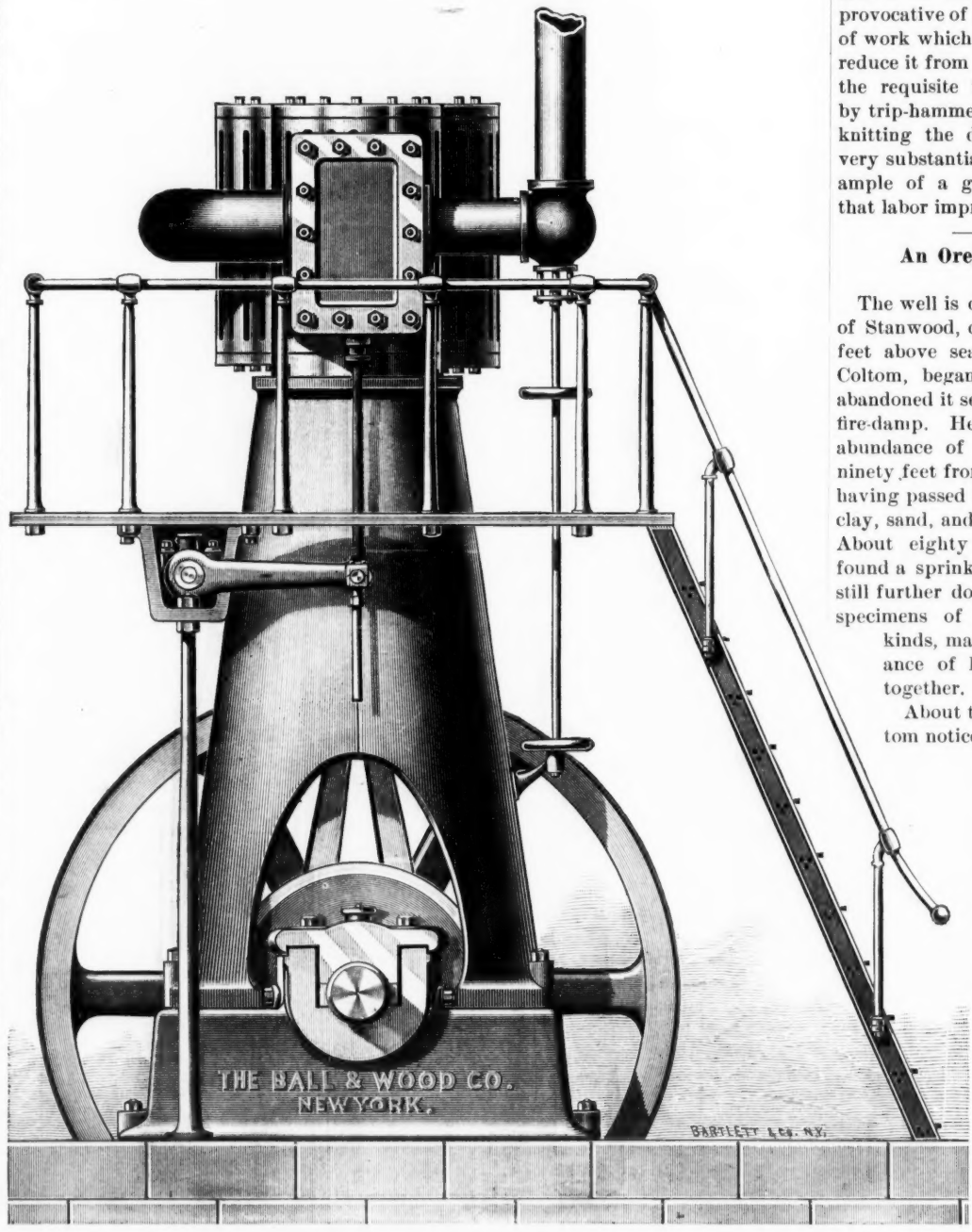
There are some grounds to support the theory that in doing this kind of work better effects should be produced by quick, sharp blows, covering but little surface, and driving the air, and all intervening substances, out from the center of the weld, than from heavy blows covering the whole surface; but practically there is found to be but little difference in the results following the adoption of either of the methods.

The interposition of thin, clean iron plates between plates of steel which are to be welded, will sometimes assist in making a troublesome weld, and sometimes a sprinkling of clean steel, or iron filings, mixed with powdered borax, will cause refractory pieces to unite kindly, but whenever it is necessary to resort to such expedients, investigation should be made to ascertain if steel cannot be obtained that will weld without so much trouble. In the modern way of manufacturing, business needs to go right straight along without resort to ingenious subterfuges.

In preparing pieces to weld by scarfing, there should be considerable attention paid to getting them into such shape that the pressure which is used to unite them will bear in such a way as to draw the scarfs together in the strongest manner, rather than that it should have any tendency to force them apart. It might seem a very simple matter to do this, but there are a good many blacksmiths who do not remember the fact that in making a lap weld there is a right and wrong side to be exposed to the drawing blows of the helper, and that, if the wrong side is up, the tendency is to pull the scarfs apart.

In butt-welding shafts, the ends which are to be united are made somewhat convex, so that they will come together first in the center. Then these ends, after being brought out of the fire at a proper heat, are placed in a swage against each other, and blows are struck on the other ends to drive them together. This swells out the stock around the joint, and the extra stock then has to be hammered down to the uniform size. The bars are now held together by the welded center, and the blows on the surface draw the outer portions of the stock, which fills up any opening around the outside of the weld, and if this elongation of the outside is continued by blows which are not heavy enough to be felt to the center, a strain is brought upon the weld. This is sometimes so great as to cause it to separate and leave a disunited portion in the center, which cannot be noticed, because the outside is so well united that no imperfection is observed. Bending the bar at the weld, and straightening it again, will not injure it if it is soundly welded, and will test the soundness of the weld, so that any imperfections may be remedied before they cause damage.

In welding piled iron, the joints between the pieces which are in line with the blow can only be brought together by the increase in the length and width of the pieces that join, and if the other pieces of the pile which cover these happen to be softer, and increase in size faster than they do, the joints will open rather than close, and will not weld up. Investigations made by the British Board of Admiralty some years ago, into the cause of the failure of so many anchors, discovered that a great deal of the poor and badly welded material was due to bad piling, the inefficiency of the blows, and cold hammering.



HIGH-SPEED COUMPOND ENGINE.—SEE PAGE 1.

In doing ordinary machinery forging the calculations are not always made so that the blows used in welding work which has to be built up will all tend to force it together. In one case of this kind a punching die was to be made, which was to be 6″ wide, 8″ long and 2″ thick. The most convenient iron for the purpose in stock was 3½″x1½″, and two pieces of this were cut 8″ long, and welded together edge to edge, and on these was laid a piece of steel flatwise, ¾″ thick, and welded. When the die was hardened it opened in the weld between the pieces of iron under the center of the steel, which remained intact. When the die was fastened in its holder it was strong enough to do its work, but the method used in making it was entirely wrong. The iron should have been welded flatwise and hammered down until it spread nearly large enough for the die before the steel was laid on. Then every blow struck on it would have tended to consolidate it.

In order to make a good union between two flat pieces, they should be thick enough so that, by the amount of hammering which is required to bring them to the proper thickness, the hard particles of each will be forced thoroughly into the interstices between the hard particles, grains or fibers of the other to a considerable depth. The steel for scythe edges, which appears so very thin in the finished scythe when it comes to market ready for the hay maker, is upwards of three-eighths of an inch thick when it is welded in. The steel for the back of the scythe is another piece, of different quality, of the same thickness, but somewhat wider, and these two pieces are laid side by side between two slabs of iron, and when the whole has been brought to a welding heat in the furnace they are firmly welded, in most cases with trip-hammers, although probably as good scythes as were ever made were welded with rolls at the manufactory of Harvey Waters, in Northbridge, Mass. The demand for scythes has fallen away to almost nothing since the mowing machines have proved their superiority, and a very excellent plant of tools, which Mr. Waters devised and had in successful operation for a number or years, now lies rusting and inactive. They were marvels of ingenuity, performing all operations upon scythes, even to the hardening and tempering automatically, making them not only similar, but, what is much more difficult, designedly dissimilar, with the precision of accurate mechanism. The very forms of his ponderous machinery were unlike anything else, and to get in amongst it in the night, when the fire's light cast it in strong relief, gave one an uncanny sensation. Waters was adjusting one of these machines one night, and asked the man who was holding the petticoat lamp to set it down and get him a wrench. The man looked the ten-ton machine all over, and couldn't find a straight, level place on it big enough to hold the lamp. There were no flat surfaces; everything was rounded. This appeared to be Mr. Waters' first discovery of this peculiarity of his designs, and his surprise struck his assistant with great force. In all these machines, from first to last, the pressure was applied in such a manner as always to compress the stock toward the welds, and none of his scythes were ever known to fail from poor welding.

The extreme thinness to which the iron is drawn on the steel along the edge is very provocative of peeling, but the great amount of work which is put upon the material, to reduce it from piles about an inch thick to the requisite thinness—whether it is done by trip-hammers or rolls—has the effect of knitting the different pieces together in a very substantial manner. It is only one example of a general rule in blacksmithing that labor improves material.

An Oregon Breathing Well.

The well is one and a quarter miles east of Stanwood, on the high land, nearly 150 feet above sea level. Its owner, O. W. Coltom, began digging it last June, but abandoned it several times because of gas or fire-damp. He succeeded in reaching an abundance of good water at a depth of ninety feet from the surface last October, having passed through successive layers of clay, sand, and some kind of stratified rock. About eighty feet below the surface he found a sprinkling of anthracite coal, and still further down large quantities of loose specimens of volcanic stones of several kinds, many of which have the appearance of having been melted and run together.

About the close of October, Mr. Coltom notices that the well was blowing out a kind of gas with considerable force, and at irregular periods of time, varying from five days to sixteen hours in duration. It would reverse the operations and begin to draw in the air with equal force, the inhalations lasting about as long a time as the exhalations. Shortly after, the gas disappeared, but the respiration of air continued with increasing force, until, at the present time, it has sufficient force to drive a large wind-mill. Not long since, Mr. Coltom went down into the well and discovered that the air was being drawn in and blown out at a point fifteen feet from the bottom of the well. It is supposed that there must be a large cavern at a distance from the well, and the air comes through a small passage leading from the cavern to the well. No cavern or passage has yet been found, as the well is walled up, and the air comes through the rocks in the wall.—*Chicago Evening Journal.*

Some time since, a brakeman on the New Haven Railroad was seriously injured, and suing the company, received a verdict of $10,000. The company thought this exorbitant, and appealed. Now the Court of Appeals has given him a verdict of $27,500.

A reader, who is a pattern maker, having noticed the cuts of machinists' tool chests that have been published in the AMERICAN MACHINIST, is desirous of seeing something from a practical man in relation to a pattern makers' tool chest.

Improved Screw Machine.

We present herewith an engraving of one of the latest forms of screw machine as now made by the Jones & Lamson Machine Company, of Springfield, Vt.

The most important special features of this machine, such as the automatic chuck and feed, both arranged to be worked by the same lever, have heretofore been described in detail by us, and we need not refer to them further at this time, except to say that it has been found in practice with such a machine, that, by the use of these devices, by which the necessity for stopping the machine is avoided, from 25 to 50 per cent. more time is secured for actual cutting operations, depending on the nature of the work being done. In the present machine, which is designated by the makers the No. 8X, the size of the hole through spindle has been increased, and the length of the spindle also increased, while at the same time the cone pulley is made larger, so that the machine is capable of doing the work done by the Nos. 8, 9, 10 and 11 sizes. In fact, the head on this machine is the same as that for the 2″x 24″ turntable turret lathe recently illustrated by us. The back gears are placed beneath the spindle, and are thrown in or out by means of a friction clutch worked by a lever at the side of the head.

The cross-feed slide is moved along the bed by means of a screw, which is turned by means of the hand wheel seen at the side of the machine.

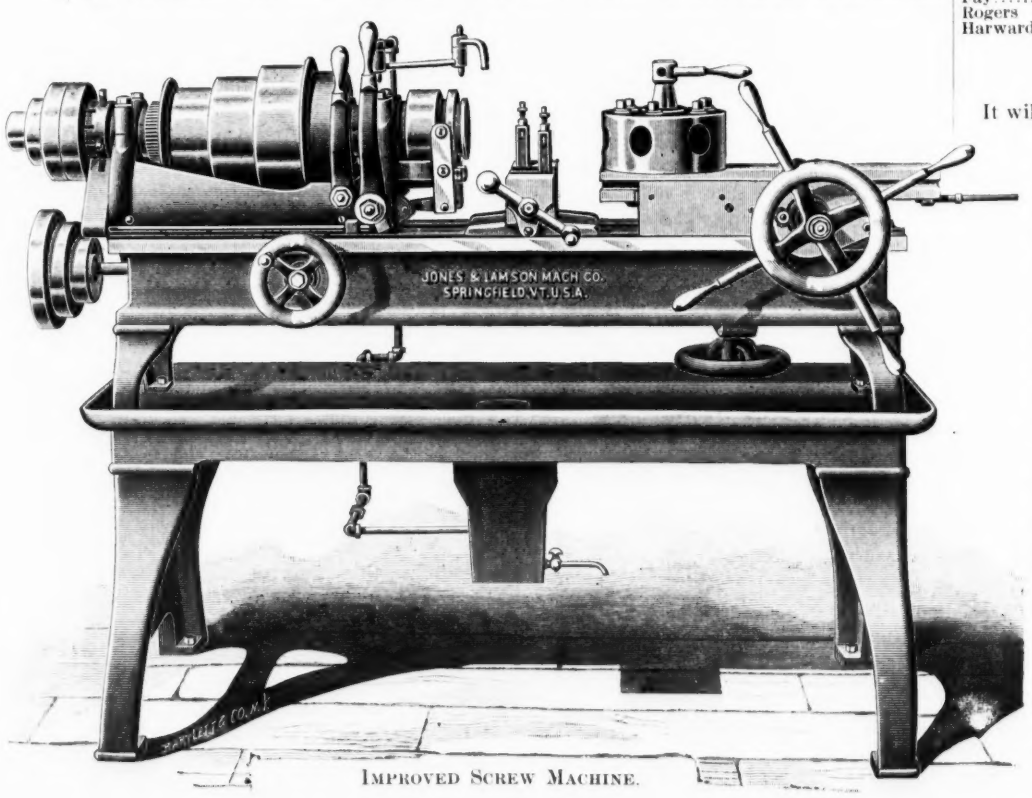
There is a power feed for the turret slide, which is sufficiently powerful for the heaviest work, and the stop for this feed and that for the hand feed are one and the same, so that there is no chance of the gears or other parts being broken by setting the positive stop in advance of the feed release.

The binder bolt is so designed that it can be quickly removed and replaced by a hexagonal nut to be set by a socket wrench. This is a great convenience, as it is often desired to run a bar through the turret. The eye or yoke-bolt as formerly used prevented the proper setting of the tool shanks.

Pains have been taken to give a regular gradation of speeds, so that all sizes of work within its capacity should have a proper speed both for turning and threading.

A rotary oil-pump keeps the oil in circulation.

This machine is provided with a triple friction countershaft. Principal dimensions: Spindle hole, 2⅛″; working length, 10¼″; swing, 16″; belt width, 3½″; weight, 2,500 pounds.



IMPROVED SCREW MACHINE.

Jet Propulsion.

BY J. BURKITT WEBB, HOBOKEN, NEW JERSEY.

(Presented at the Providence Meeting of the American Society of Mechanical Engineers.)

The following contribution to the subject will, I hope, be of interest. It needs but little introduction, since, to a great extent, it explains itself. A year or two since, when the subject was a live one in certain quarters, several students took special interest in the mechanical principles involved, when we came to them in the course of instruction. I laid down the law, and, as usual, enforced it by illustration and argument, but it so happens that these principles, like many other good ones, are unacceptable to the unregenerate mind. When, therefore, I learned that some had gone away and quietly tried the thing, I experienced one of those moments of satisfaction which come to every successful laborer in a good cause; I was glad that nature had had the chance to vindicate her own laws. The subject is not one which is, ordinarily, well understood; in fact, many engineers are totally wrong in their conception of the way in which a jet acts, and it will be a satisfaction to me if this letter contributes towards a more correct knowledge of the facts.

DEAR SIR: *April* 12, 1891.

The following is a description of some experiments which I made with water jets in the fall of '89, to prove that the reaction of a jet is the same in air as in water.

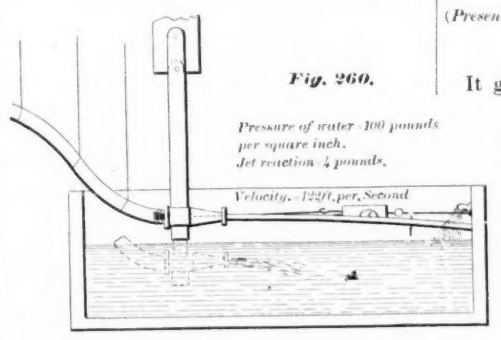
These trials were made to disprove a statement that a stream of water issuing from a nozzle under water reacts upon the surrounding water and tends to drive the nozzle in the opposite direction to that of the jet, in the same way that a solid rod, issuing from the same nozzle, would react upon a stone wall.

I felt certain as to the results of the experiment, because *you* had told me what they would be beforehand.

The arrangement for measuring the reaction is shown in the accompanying sketch (Fig. 260).

The tests were made in a large tank, and the water was supplied by a steam pump at a constant pressure of 100 pounds per square inch. The pump had a steam cylinder of four inches, and a water cylinder of two and three-sixteenths inches diameter, and a stroke of two and a half inches.

Fig. 260.



The nozzle was fastened to the foot of a pendulum four feet long and connected to the pump by a flexible half-inch rubber hose. The hose was hung by strings, so that the stiffness was inappreciable. The pendulum at the nozzle was connected to a spring balance by a cord about four feet long. When the jet was flowing the pendulum was brought to the vertical by moving the balance, and in this way every force due to the deflection of the pendulum was eliminated. The pendulum was first hung so that the nozzle was a little above the water, and the reaction found to be four pounds. The pendulum was then lowered so that the nozzle was about four inches below the surface of the water, all other conditions being the same, and the reaction was found to be the same—four pounds. The only difference was that when the nozzle was under water the balance hand vibrated a little more.

When these results were reported to the party making the statement, the rejoinder was made that "the reason was that the jet struck the opposite side of the tank"—five feet distant—"and so pushed back on the nozzle."

I therefore measured the reaction in air again with the pendulum hung from the roof of the house, twenty-five feet above the ground, so that the jet broke into spray before it struck. All the conditions were the same as before, and the reaction was the same—four pounds. I then put a flat plate on the pendulum, and let the jet impinge upon it, and the pull was the same as the reaction—four pounds. I afterwards used a similar apparatus (but more delicate) with a constant head of water—about 10 pounds per square inch—from an elevated tank. The only difference from the first trial was that the pendulum was held in a vertical position by a delicate spring balance when the jet discharged in the air, and then nothing was altered, but the water allowed to rise in the tank until the nozzle was two inches below the surface, and the balance reading remained *absolutely the same*.

I hope these results may be of some service to you, and thanking you for your kindness and instruction while I was at Stevens' Institute, I remain,

Truly yours,

CHAS. J. EVERETT, JR.

Some Experiments with a Screw Bolt.

BY JAMES MCBRIDE, BROOKLYN, N. Y.

(Presented at the Providence Meeting of the American Society of Mechanical Engineers.)

It goes without saying that the screw is one of the most useful mechanical powers, and among its many good qualities is that of not "overhauling" when loaded. A large part of its efficiency as a mechanical power is sacrificed to obtain this valuable property; but, aside from the necessary loss to accomplish this result, I doubt if it is generally known how much of the total power applied to turn the nut on an ordinary screw bolt is lost in friction. I am quite sure that I did not, and a number whom I asked for the information, and whom I supposed ought to know, apparently knew as little about it as myself; and it was to get some practical knowledge on the matter that these experiments were made.

The experiments were made with an ordinary two-inch screw bolt, such as can be bought anywhere in the market, and it was not specially prepared for the occasion. The pitch of the thread was $\frac{22}{100}$″ (four and one-half threads to the inch), and of the standard V shape; the nut was not faced and had a vertical plank, and one end of a soft and very pliable rope was attached to the handle of a wrench and passed over a pulley nine inches (9″) in diameter, the top of which was also on a level with the nut and immediately in front of the operator. To the other end of the rope were attached weights which rested on the floor. The operator was required to grasp the wrench with one hand on each side of the rope, where it was fastened to the wrench, and turn the nut on the bolt, which he could only do by raising the weight from the floor. This apparatus was designed to compel the operator to keep the wrench on a level with the nut, or nearly so, thus making the conditions, as nearly as possible, the same as when he applied his power to turn the nut on the loaded bolt.

It was found after many trials, by different men, that they could by this device lift weights varying from 182 to 267 lbs., the latter weight being raised just clear of the floor by a very powerful man.

Following are the results of the trials with the weights:

Clark	267 lbs.
Sweeney	227 lbs.
Fay	182 lbs.
Rogers	208 lbs.
Harward	182 lbs.

When the wrench was applied to the nut on the loaded bolt, it was found that the men could just move the nut with the following length of wrench:

Clark 8	inches =	Radius, Clr.	=	50.26 inches.
Sweeney..13	inches =	"	=	81.68 inches.
Fay.....14½	inches =	"	=	91.10 inches.
Rogers ..13	inches =	"	=	81.68 inches.
Harward..14¼	inches =	"	=	89.53 inches.

The length of wrench was measured from the center of the nut to a point between the hands, and was taken as the shortest length of wrench with which the nut could be moved; and the operator was allowed to jerk or surge as he liked, with both feet on the floor, and keeping the wrench as nearly horizontal as possible.

The theoretical value of a two-inch screw bolt with a 22-inch pitch, and under the foregoing conditions, is as follows:

	lbs. : lbs.		
Clark ....22″ : 50.26″ : : 267 : 60,997			12.29%
Sweeney..22″ : 81.68″ : : 227 : 84,279			8.899%
Fay.....22″ : 91.10″ : : 182 : 75,364	7,500		9.95%
Rogers ..22″ : 81.68″ : : 208 : 77,224			9.71%
Harward 22″ : 89.53″ : : 182 : 74,065			10.12%
		5)	30.96%
		Mean,	10.19%

It will be seen from this that the practical value was only a mean of 10.19 per cent. of the theoretical, and that 89 81 per cent. of the power applied to the wrench was absorbed by the friction of nut on the washer and on the threads of the bolt.

While these tests, made as they were in a crude way, are not absolutely correct, they go to show that only about 10 per cent. of the power applied is converted into strain on the bolt.

Since beginning this paper two cases have come under my observation, which go to show how little is really known of the strains that are put upon screw bolts under various conditions.

One was that of some ¾-inch bolts, 11-inch pitch (9 threads to the inch), the nuts of which were being screwed up with a wrench 28 inches long, operated by two men. Leaving out the element of friction, and assuming the combined force applied by the men to be only 100 lbs. (they being in a sitting position and not able to exert their full force), they should have put a strain of 159,927 lbs. on the bolt, which is about 5½ times more than its tensile strength.

It is very evident that no such tensile strain was put directly upon the bolt, although a number of them were broken, the friction of the threads alone being sufficient to so lock the two parts together that the bolt was twisted off just below the nut.

The other was that of a 3½ inch diameter bolt, .25 inch pitch (4 threads to the inch). The nut and its bearing were faced and well oiled, the wrench was 3 feet 6 inches long, having an eye at one end to which was attached a double and triple pulley block

tackle, operated by four men. Four men with such a tackle can just raise 1,700 lbs., which, applied to the end of the 3 feet 6 inch wrench to turn the nut on the bolt, should raise 1,794,452 lbs., which is about 4.5 times the tensile strength of the bolt. As in the former case no such strain ever reached the bolt, but assuming that 10 per cent. of it did, it will be seen that this bolt was strained so as to only leave a factor of safety of 2.1 to 1.

The text-books are painfully silent on this subject, and leave the reader in a very uncertain frame of mind how much to allow for this element of resistance. I have found but few experiments recorded even on apparatus specially designed for the purpose, and none at all on the every-day cases which arise in practice. Following are what some of the authors say:

Tomlinson, after figuring out the theoretical value giving a certain result, says: "This is of course omitting the friction, which, in the case of the screw, is *very great*."

Oliver Evans, after discussing the theory and giving an example, says: "But this is supposing the screw to have no friction, of which it has a *great deal*."

Overmans says: "For calculating the effect of a screw we employ the formula to the incline plane, *making due allowance for friction*," but don't say how much.

Prof. Ball says: "Experiments showed in two cases respectively about $\frac{1}{3}$ and $\frac{2}{3}$ of the power was lost."

Trautwine says: "In practice the friction of the screw (which under heavy loads becomes very great) *makes the theoretical calculations of but little value*."

Weisbach says: "The efficiency is from 19 to 30 per cent."

The Mechanical Engineers at Providence.

The American Society of Mechanical Engineers began its twenty-third meeting at Providence, R. I., on the morning of Tuesday, June 23, with headquarters at the Narragansett Hotel, the sessions being held at St. John's Hall.

The assembled engineers came to order at a little past ten o'clock, when Mayor Smith was introduced. He warmly welcomed the visitors, and gave some interesting facts in relation to the industries of Providence, and the future prospects of the city.

President Hunt responded, thanking the mayor and the citizens of Providence. Among other things he said the present was the largest attendance at any meeting, not only of mechanical engineers but of any kindred society that had ever held a meeting in America, and, he believed, in the world. Mechanical engineers were, he said, usually guided by mathematical formulas and sound practice, but at this time they had trusted to Providence.

Then the mayor withdrew, and the meeting was formally called to order by President Hunt, who spoke, in doing so, as follows:

Gentlemen of the convention, permit me, in calling you to order for business, to take this occasion to thank you most heartily for the honor which you saw fit to bestow upon me—one which I think I venture nothing in taking you into my confidence to say that I have received and accepted with a just and honest pride. But you must remember that if I am going to make you any sort of a good president it can only be done through your kind assistance. You have given us a great meeting in members; I believe we will have a good meeting in papers.

The life of this society, as has been demonstrated in some of the troubles of some of our sister societies, depends upon our papers and the discussion of the papers. So I trust that you have all come here prepared to take up the papers which may be presented, and the topical questions which we may have submitted to us, and give the society the benefit of your experience and valuable judgment in discussion. Remember that your president is all very well, your council an excellent one, and your secretary is most admirable, but you individually make the society, and you cannot expect to have a good one and leave it entirely to your servants; you must execute the work yourselves.

Papers were presented and discussed at this meeting as follows:

"Two Rope Haulage Systems," by R. Van A. Norris.

"A Belt Dynamometer," by S. P. Watt.

"A New Belt testing Machine," by G. I. Alden.

"Test of a Triple-expansion Engine," by J. T. Henthorn.

As we shall, as space permits, publish some of the papers presented at these meetings, and abstracts of others, their discussion will not be published in this connection.

NEW MEMBERS.

At the conclusion of the discussion of Mr. Henthorn's paper the secretary read the report of the tellers on the election of members. From this it appeared that there had been added to the list two honorary members, 96 full members, 36 juniors; four associates, and five juniors had been promoted.

The secretary then announced that notice had been given to offer an amendment to that section of the rules which provides for putting only one man in nomination for a vacant office, so that two names must be put in nomination.

REPORT ON STANDARD METHODS OF TESTING.

Mr. Henning then offered the following report for the committee on Standard Methods of Testing Materials:

The committee would report that a great deal of work has been done in the last six months. Over 500 letters have been sent to engineers and manufacturers, and also many letters have been sent to Europe, and we have received replies complete, excepting in France, from which we have not yet received complete lists. We have received a great many interesting replies, especially in regard to the possibility of co-operating to make the work of the committee of an international character. The German engineers have notably requested that action be taken definitely for the conference to be held in Vienna in 1892, when it is proposed to take action respecting our World's Fair in 1893. The committee expect to make a report in November, which will show fully what has been done. It may be further stated that, through the labors of different associations, both the conventions at the last exposition in Paris and the German conference, and the work done here, have led to the possibility of putting the matter on a scientific basis. The first steps have now been taken in that direction, and instead of making the work tentative, it will be so that it can be understood and compared with all work that is done, and that we need not use twenty different standards in order to define what quality material is; that the testing can be done in such a manner that the report given can be used for material in different shapes when the test has been made upon a particular shape. It has been discovered that there is a relation between results obtained of test pieces of different shapes. This is, I think, something new, and was first pointed out in 1880. The committee have issued a supplementary report, which has not yet been returned from the printer, but which it is expected will be issued in a few days. In that there is a translation of the work done by the last conference in Berlin, held in October last, and an appendix to that report is an investigation into the comparative elongation of different shapes of testing. It was made at the Imperial Laboratory Department of Roads and Railways in St. Petersburg. This, in connection with the other work, will form a voluminous report which I think can be offered next October or November, although, if it is not out, I hope members will have a little consideration, on account of the great volume of work.

DISCUSSION.

MR. KENT: In connection with that, I would say that I received not long ago from the secretary of the Society of Civil Engineers, a circular letter, which showed that that society is at work on the same subject through a committee. I think it will be very unfortunate if these societies bring in independent reports, without having some sort of co-operation with each other, so that the two reports shall agree in general substance as to the recommendations. It would be unfortunate if two American societies should bring in different reports. It would delay the establishment of a standard. Therefore I think there should be some method of co-operation brought about between the two societies.

MR. HENNING: The chairman of that committee—of which our president is a member—has addressed us on the very subject, and a committee have now in hand, and propose at the next meeting to discuss the matter thoroughly, and attempt co-operation, because we are well aware of the fact that there can be no difference of opinion on this subject. It is simply a question of matter of fact, and when we sift the fact, why, we must come to the same conclusion. The reports may not be identical, but they cannot be antagonistic. I do not think there is any idea that there will be any conflicting points in the two reports. The committee is attempting to have a joint consideration of a plan, and will very surely take the necessary steps to have a joint meeting of the committee of the Society of Civil Engineers and our committee shortly.

President Hunt assured the members that there was not the slightest danger that the report of the Civil Engineers would be issued in advance of theirs.

LOCOMOTIVE TESTS.

The Committee on Standard Methods of Conducting Locomotive Tests reported progress through Secretary Hutton.

UNITS OF MEASUREMENTS.

The Committee on Standard Units of Measurements reported progress, and asked to be continued. The committee have had joint meetings with committees of other societies, and have adopted some resolutions.

The morning session then, with some announcements by the secretary relating to sight-seeing in the afternoon, was closed.

TUESDAY AFTERNOON.

The afternoon was given to sight-seeing. Among the places visited were the Gorham Company's works at Elmwood (a suburb of Providence), the Nicholson File Company's works, the Rhode Island Locomotive Works and the Builders' Iron Foundry.

At the Gorham works the visitors, including many ladies, were shown through the magnificent works of this company, which employs (at a guess) 1,000 hands, mostly in the manufacture of sterling silver ware. These works are, no doubt, the finest of the kind in the world, and the visitors, particularly including the ladies, were much interested in the various processes of manufacture. Every lady—there were possibly one hundred of them—received a beautiful silver spoon in a special case, and they agreed that the Gorham works were as near right as could be. And it is only fair to say that the engineers were pleased at seeing, to many of them, something novel in the way of work ing up the products of nature into things useful and highly ornamental. The writer, even in view of what appears hereafter, violates no confidence in saying that the processes of making silver were extremely interesting to the mechanic, and that a great amount of mechanical skill is required in all departments.

The buildings are grand, the surroundings beautiful, and cleanliness prevails.

At the Nicholson File Company's works there was a genuine surprise for a large percentage of the visiting engineers. Some idea of the magnitude of these works may be had from the statement of the fact that 1,800 dozen files are made per day, and that at another works owned by the company 600 dozen are made. And these files are almost entirely cut by machinery. Whether or not machine-cut files are better than those cut by hand, it is plainly manifest that the machines employed are labor-saving, in that they cut a file in a fraction of the time required by the hand process. The machines for file-cutting have been developed at the works, and they are as fine in their operation as anything likely to be imagined.

At the Builders' Iron Foundry the large mortars being constructed for the United States government were seen in all stages of construction, and those who visited these works were enthusiastic in their praise of what was being done.

TUESDAY EVENING.

At the session Tuesday evening papers were presented as follows:

Comparison of Economy of Compound and Simple Cylinder Engines, by D. S. Jacobus.

Flexure of Thin Metallic Rings, by De Volson Wood.

The Premium Plan of Paying for Labor, by F. A. Halsey.

Application of Hirn's Analysis to Engine Testing, by R. C. Carpenter.

Application of Hirn's Analysis to Multiple Engines, by C. H. Peabody.

Mr. F. M. Wheeler then gave notice as follows:

I take this opportunity to give notice of certain amendments, namely, an amendment to the constitution, raising the admission fee from $15 to $25, and the annual dues from $10 to $15, and juniors promoted to full membership to pay $15. We find that the expenses of running the society are such that it has been deemed advisable to adopt this course.

WEDNESDAY MORNING.

Papers were presented Wednesday morning, as below:

Notes Regarding Calorimeters, by R. C. Carpenter.

Jet Propulsion, by J. B. Webb.

Performance of Steam Reaction Wheels, by J. B. Webb.

President Hunt then exploded a bomb, figuratively speaking, by announcing the action of the council at a meeting the evening previous. This action was in effect, that visiting engineers should, while visiting manufacturing establishments, leave their note-books behind, and particularly relegate their kodaks to the lumber-room. Possibly some of the members on Tuesday had jotted down what they had seen, and perhaps "kodaks," that never tell anything, had been brought into service. But we venture to say that there had been no intention to steal anything.

If a little digression may be allowed, we agree that those who have something to show are never afraid of what they have being seen, and we might further say that the koda k and its numerous contemporaries are simply innocent playthings in the hands of an engineer. But it is plain that all do not think alike. This action of the council is what we referred to when it was intimated that no effort would be made in these columns to "give away" any of the secret shop processes observed. Many things were seen that would interest our readers, but no "secrets" will be divulged.

After discussion of "Topical Queries," which will be referred to hereafter, then the paper, "Steam Engine Efficiencies," by R. H. Thurston, came up, followed by "Effect of the Steam Jacket on Cylinder Condensation," by W. W. Bird, and "Steel Castings," by H. L. Gantt.

WEDNESDAY AFTERNOON.

Wednesday afternoon the members visited the Wm. A. Harris Steam Engine Company's works, the Brown & Sharpe works, and the works of the Armington & Sims Engine Co.

WEDNESDAY EVENING.

Wednesday evening the engineers and ladies attended a reception tendered by the citizens of Providence, at which all were more than pleased.

THURSDAY MORNING.

There was all the appearance of a rush Thursday morning, in order to get through the business of the session. As usual, a little more than the allotted time had been given for the presentation of papers, and it is always hard for the president to choke off discussion. But President Hunt grasped the situation, and, while he did not unduly stick to the letter of the law in this respect, he kept the members within due bounds.

The following papers were presented and discussed Thursday forenoon:

"Manganese Steel," by H. M. Howe.

"Performance of a Pumping Engine Against a Head of Two Thousand Feet."

"A Blast Furnace Blowing Engine," by F. W. Gordon.

"Some Experiments with a Screw Bolt," by James McBride.

"Mechanical Stokers," by W. R. Roney.

This was the last paper on the list. After its reading a little time was given to discussing "Topical Queries," to which we shall refer in a later issue.

After passing the usual resolutions of thanks, and some announcements by the secretary, President Hunt declared the summer meeting of 1891 adjourned.

The next meeting will be held in New York, the time to be announced later.

THURSDAY AFTERNOON.

Thursday afternoon there was an excursion and clam bake. In addition to the clam bake, there were many features of the excursion that interested the engineers. In other words, the clam bake was no more than the conventional way, in expression, of having a delightful sail on salt water; everybody was more than gratified.

FRIDAY.

The session of the society was through before Friday, but many members remained to visit the works, the doors of which had been thrown open for the occasion.

It is impossible to notice all these works, but it may be said that Providence was an open city during the meeting of the mechanical engineers.

The summer meeting of 1891 was declared to have been the most successful ever held, and it was agreed that Providence was an excellent place for meeting.

A Small Steam Launch.

BY HENRY J. GIELOW.

The principal dimensions are: Length over all, 19 feet 6 inches; length on water line, 17 feet 5 inches; beam, extreme, 4 feet 6 inches; depth of hold amidships, 2 feet 7 inches; sheer forward, 8 inches; sheer aft, 3 inches.

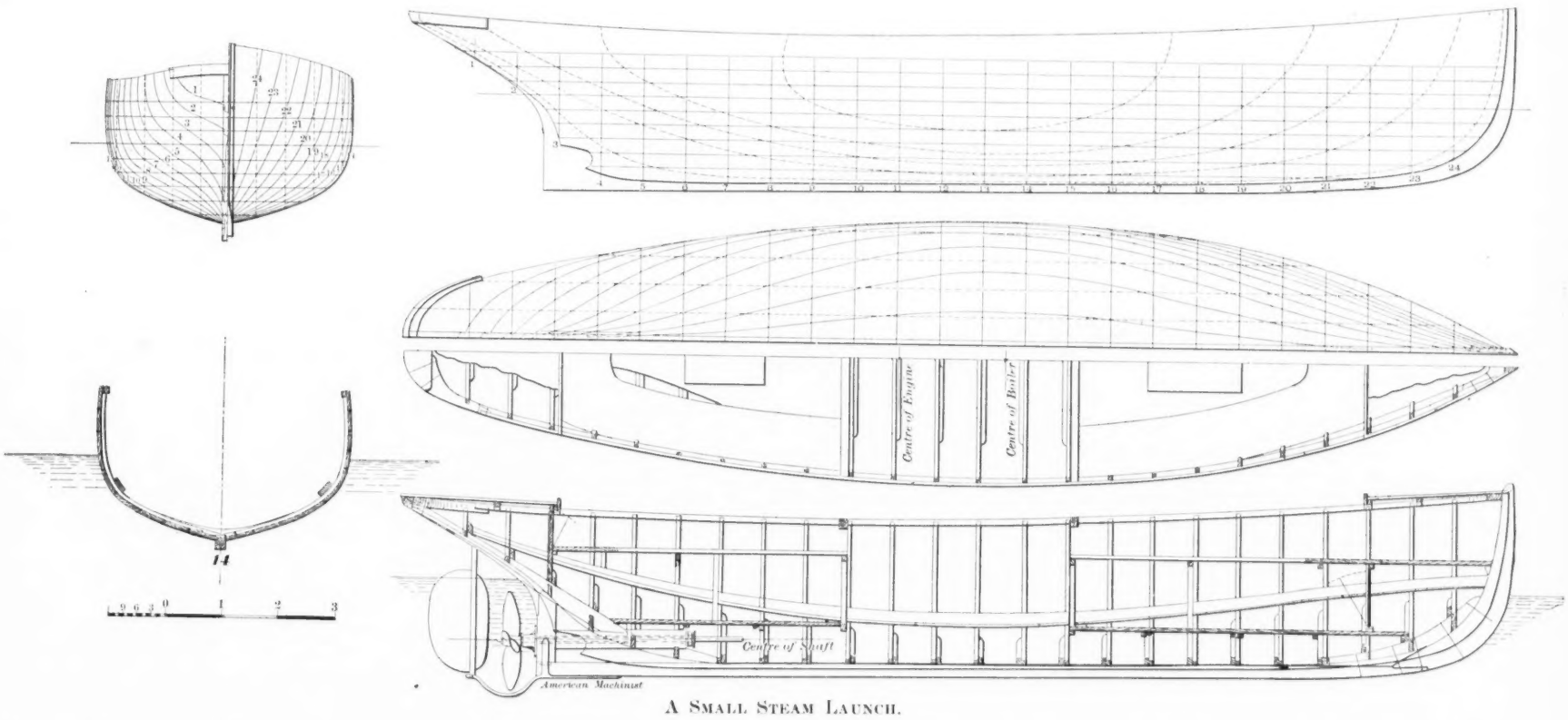
This boat is of about the same water line length and beam as the rowboat described in the AMERICAN MACHINIST of May, 1891, but differs from it in the following essential details:

1. It will be observed that the bilges are fuller or "harder," the effect of which is to give greater carrying capacity, necessary on account of the weight of engine, boiler, shaft, wheel, coal, etc., and greater stability to overcome the rolling tendency due to the high fixed weights, such as engine and boiler. In a rowboat any rolling tendency is overcome by the persons in the boat leaning towards the emerged side; finer lines and an easier rowing boat being obtained by cutting away the bilges.

2. The lines of the stern are carried out in an overhang, which gives the necessary protection to screw and rudder while alongside of dock, and affords a proper place for fastening and fitting the rudder.

3. The construction is somewhat stronger, so as to stand the vibration and weight of machinery. The keel is 2¼ inches by 3 inches stem deadwoods, and stern post 2¼ inches thick; frames will be spaced 9 inches between centers; ribs, ⅝ inch by ⅝ inch, and floors 1 inch by 1½ inches; outside planking, ⅝ inch in thickness. At turn of bilge, a bilge stringer 1 inch by 3 inches will be worked, and at bow and stern there should be a cuddy deck of ¼ in. white pine, as shown on drawing. Just forward of boiler the sides of boat should be tied together by an oak beam 1¾ inches by 2 inches, and a similar beam should go across just abaft of engine. Coal bunkers should be placed on each side of engine and boiler.

Engine to have a stroke of 4 inches, and a piston diameter of 4 inches, and should not weigh more than 300 pounds. Boiler to be 21 inches in diameter, and 33 inches high, containing circular fire-box 17 inches in diameter, and 15 inches in height, and 52 tubes 1¼ inches in diameter Weight of boiler, about 300 pounds.



A SMALL STEAM LAUNCH.

The propeller is to be three-bladed, 21 inches in diameter, and 33 inches pitch; shaft of steel, ⅞ inch in diameter.

An English Opinion of American Iron and Steel Industries.

The following are extracts from remarks made by Sir James Kitson, at the recent meeting of the Iron and Steel Institute, regarding the iron and steel industries of America. One feature which struck the English visitors was the fact that the American skilled artisan puts forth more physical effort and produces more work in a given time than the English workman or the workman of any other manufacturing community, and this conclusion was verified by observations in various parts of America. The productive power of American workmen is greater than that of English workmen in the same time. Their working hours are longer, but their remuneration is greater. The workmen in America, however, recognize that the extreme physical effort put forth saps the vital energies and cuts short the career; in short, they understand that continual work at high pressure does not pay in the end. This remark applies with equal force to the employers and to the employed. Competition between manufacturers is keener than in England, and this fierce competition reacts on the men. The employers of Pittsburgh are men who are directly engaged in the management of their own businesses, and seemed for the most part to have risen to the head of establishments by their natural skill and business aptitude. They are exceptionally active, energetic, and full of resource and enterprise, and are mainly practical rather than scientific men. It will, however, be found that many of the younger men who are responsible for the scientific work have for the most part passed through the course of study of one of the numerous technical schools which have been established in America during recent years. Altogether the impression produced on the visitors by Pittsburgh was that, with its immense natural resources, and the activity and intelligence of those who manage the works, that city is able to compete with any manufacturing city in the world. Sir James Kitson thinks that with such extraordinary advantages as its manufacturers possess, their industrial position is impregnable, without the artificial barriers which they take so much pains to set up around them. The English visitors were also much impressed with the energy and activity, and the consequent phenomenal development of Chicago. The southern States have made great developments in industry and trade during the past dozen years, and are now able to strive against their northern competitors.

Sir James Kitson concluded by asking what are the leading characteristics of those who are engaged in the chief industries. He answered that these are quickness to adopt improvements, and readiness to adopt scientific methods in the processes of manufacture. He points out that in the departments of iron and steel manufacture, great as has been the industrial growth of America, marvelous as are the mechanical achievements of Americans, the English can still claim that the inventions which have brought the manufacture of iron and steel to its present state of perfection are of English origin. The Americans have not invented, they have improved. Sir James Kitson says that the high standard of education, and especially of technical education, of the people of America undoubtedly is much to their advantage. He recognized everywhere a promptness to discard old plans, and an alertness to adopt the newest and the most scientific methods of production. He thinks, however, that there need to be no ground for apprehension as to the competition of the United States. The insular position of Britain, and its abundant supply of labor and accessibility to mineral products, make it, in his opinion, certain that England, as a producer of iron and steel, will continue to hold the leading place in the neutral markets of the world.

The practice in western shops in which Corliss engines are built is largely in favor of bored guides. Is there any good argument against such guides, bored, as they are, to large radius?

First Chinese Locomotive.

MADE OUT OF SCRAP-IRON BY NATIVE WORKMEN IN 1881.

In 1878 coal mining was begun at Tongsan, about eighty miles northeast of Tien Tsin, says "Railways in North China." It was arranged to build a railroad twenty-nine miles long, from the mines to the nearest navigable water, that is, to Lutai on the Peh Tang Ho. It was then, in 1878, that Mr. Kinder went out as a resident engineer. Before the railroad work could be begun, the authorities had decided to operate a canal twenty-one miles long, to a point within seven miles of the colliery, and to connect the canal and colliery by a tramway to be worked by mules; this was done.

Fortunately, the gauge of 4 feet 8½ inches was, after much difficulty, sanctioned, but it was stipulated that no locomotives should be used; but before the track was completed this had virtually become a dead letter The country was easy, but several sharp curves were introduced to avoid graves. Subsequently the owners of these graves, objecting to the noise so near the bones of their ancestors, allowed the remains to be removed, and the line was rectified. This track was laid with 30-pound steel rails, flange section, and ballasted with broken limestone.

During the winter of 1880–81 Mr. Kinder built a locomotive in the shops of the company. It was built entirely of odds and ends which could be procured without attracting attention. The boiler belonged to a portable winding machine. The wheels were 30 inch Whitney chilled wheels, which had been bought as scrap castings, and the frames were made of channel iron. Before this was finished its preparation became known, and orders were issued that it should be stopped.

Eventually, however, through the offices of Li Hung Chang, Mr. Kinder was allowed to finish the locomotive, which was christened the "Rocket of China," just 100 years after the birth of George Stephenson. November 8, 1881, this engine took a party of officials over the line at a speed of twenty miles an hour, and after that the objections to locomotives were virtually abandoned. Mr. Kinder says there is little doubt that if this engine had not been built as it was—in China and by native workmen—it would never have been allowed to run, and the use of locomotives would have been postponed for many years.—*The Manufacturers' Gazette.*

LETTERS FROM PRACTICAL MEN.

Molders' Apprentices.

Editor American Machinist:

There is a great deal in the AMERICAN MACHINIST every week from machinists, that is of interest to other machinists and apprentices. I think molders should write more that would be in the way of helping molders' apprentices.

The molders' trade is a hard one to learn; learning it in four years is out of the question. The foreman is too busy to give much instruction, and the journeymen do not want to be bothered, so the apprentices ought to have an opportunity to read more of their trade. When I was serving my time, I bought one of the first books, by Thomas D. West, on molding, and I got many excellent lessons from it.

One thing an apprentice should do is to listen to advice from the foreman when making a piece. Don't imagine you could make it better this way or that way. You lack one great thing, that is, experience. Don't try to teach your foreman; try to get him to teach you. Don't bore him continuously for better work; show him just as far as you can that you can do well the work he gives you, and better jobs will come. But in case you, after deliberation, think you are not advanced fast enough, quietly state your opinion to the foreman, and ask him kindly to give you a better show. Don't get mad and make a disturbance over it.

A boy should learn the molders' trade in a machinery or jobbing shop; he cannot help getting a variety of work during his four years' apprenticeship. After serving his time, he should work say two years in another shop of the same kind, and four years on housework and work of that character; all this before he calls himself a molder.

He should acquire a knowledge of core making by some sort of hook or crook, for he is liable to be called upon to make a core at some time or another.

For example: I was once given a water jacket to make. It was about 18 inches square by 3 inches deep. The core was covered with iron, with only two $\frac{3}{8}$-inch holes on the top to take off the vent. I made the job, and at night it went up to the roof, so to speak. The next night the result was the same. Then I went into the core-room and broke one of the cores, and found the vents were all shut off from where they were to escape. The foreman told me to make the cores the next day, so I mixed my sand one to eight with resin, and made some glue water to wet the sand with. I first rammed tightly about one inch of sand, then laid on some fine cinders, put in the rods to lead the vent to the small holes, put in more cinders and rammed up to top of box. I finished up the cores, and while they were drying I made two molds, set the cores, and the castings were good.

Another time, in the shop where I am now working, the core maker who made cylinder cores was fired, and the new core maker did not understand making such cores. So a molder was taken off the floor to show him. These are reasons why boys should learn to make cores.

J. K. SWIRES.

Setting a Planer Head—Tapping Jigs.

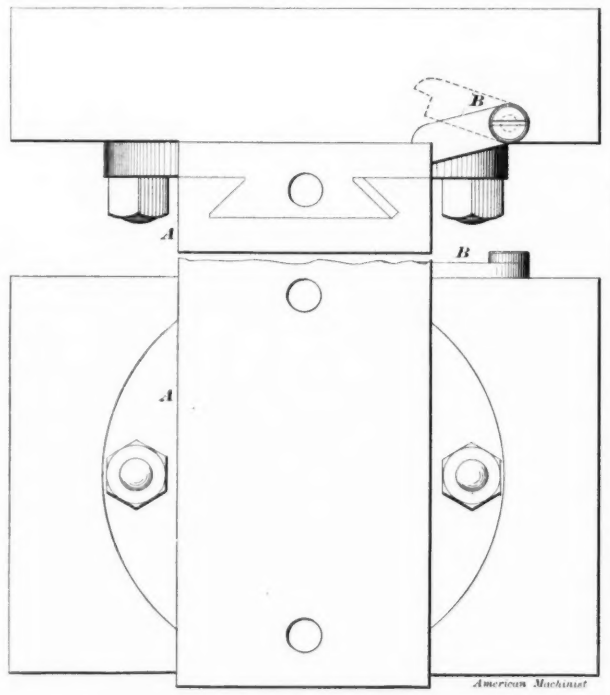
Editor American Machinist:

I wish to call attention to what I call a fault with most planers I have seen. The illustration is supposed to represent a planer head, and the fault I wish to speak of is at *A*. It would be often convenient if we could set the head square, or to some angle, by the use of a square or bevel from the platen, but we are often defeated in this, for the reason that the builder was not particular to have this side of head parallel with slide. I think most mechanics will agree with me that this is a fault, and one that should be and could be easily remedied. I would like to see this side accurately scraped, and without polish. We see on most planer heads the usual number of straight line marks, and find them here, as with the lathes, of no earthly use except for the very roughest work. Of course it is possible to set a planer head square enough for practice by a properly made line, but it is hardly practicable for men as they go. At *B* I show a little button or latch that I have seen in use with good results for setting the head square. Any one who uses a planer once with such a convenience will never doubt its value. It saves time. There is no need of having good light, for you can set the head as well in the dark. The only thing to look out for is dirt in the notch.

Some such convenience as this, or graduated dials on the feed screws, are, as a general thing, better appreciated by mechanics than extra power to push off a few more pounds of stock in an hour.

About tapping jigs. In your issue of March 12 I gave what I consider to be a good plan for tapping or reaming jigs. Bell Crank in a later issue says there are two objections to my plan for a tapping jig. I think he will find if he tries the plan that his two objections are imaginary. In giving the plan I had most in mind a reaming jig; that is, to keep a reamer square when reaming holes in thin pieces, where the hole is not long enough to guide the reamer.

For ordinary tapping I use such jigs usually without clamping, or without a plug for centering. When tapping on a flat surface, I just set the jig on, and while starting the tap keep watch around the base, to see that it does not raise off the surface anywhere; where the jig raises I favor the tap that way. For a special purpose we can get up jigs that might be more suitable, but for a general tool I believe this to be good, for it answers the purpose for either tap or reamer. For a reaming jig we usually want something more accurate than for tapping. In reaming we usually have to clamp the jig, and as the shank of reamer is the only part we want to fit jig, the reamer will not do very well for centering where accuracy is wanted, so the need of a plug. I do not see the need of having a bushing follow the tap down, for there is no need of having anything to guide the tap after it is well started, and I believe the shanks of most taps are long enough for this. For this special purpose, the rig shown by Bell Crank for holding tapping jigs is good, but it could not be a general tool.



SETTING A PLANER HEAD.

I have seen special taps made with large shanks, say for a $\frac{3}{4}''$ tap a $\frac{1}{16}$ shank, and the hole in tapping jig $\frac{13}{16}''$ to fit; they make a first class rig, but of course require special taps.

A MECHANIC.

A Small Shop's Apprentices.

Editor American Machinist:

The sum of the evidence in the apprentice question indicates that the old-fashioned way is the best after all. After reading all sides of this topic *verbatim, literatim, seriatim et nauseatim*, I suspect some of the writers have never served an apprenticeship, and do not comprehend the meaning of the term. The opinion that any boy, however shrewd, can "learn the trade" in two years, is not warranted by experience. He may become proficient at one or two machines, and acquire a position half way between the machine and the machinist—a machiner—comparatively—but he is not fit to send out by himself to do work. It used to take three years, in the old times, to get a grip on the trade, and about ten years more to verify the title to it, but we did not have the improved brain-inspiring tools then that we have now, and perhaps too much value was placed on a bit of experience. Nevertheless, there were some good workmen, even if they did not come by the royal road.

In our little shop we employ six or seven apprentices who begin at seventeen or eighteen, and go through the usual routine of chipping castings, drill press, bolt cutter, pipe fitting, turning nuts, etc., for about six months. They are then promoted to a larger and better lathe, where considerable brains is required. This is the rock they generally split on, about two-thirds going by the board; the fittest only survive—the born mechanics, as it were. After this they go from lathe to lathe, planer shaper, vise work, floor work, and setting up machinery if qualified, following each other in routine a few months apart for three years. The wages are three dollars a week at first, increasing to seven and a half during a part of the last year, averaging enough to keep the "wolf away." Those who graduate are usually good general workmen, and command from twelve to fourteen dollars a week at once. There is some loss of time involved in changing the boys from one job to another, but it makes better workmen, and it pays the boys and the firm mutually, notwithstanding; any other than an all-round training does not do the boys justice, nor bespeak the honesty of the employer. But the almighty dollar, not honesty, is the usual motive power on this royal highway that is so much sought after.

C. W. CRAWFORD

The Industrial University.

Editor American Machinist:

As the criticism brought out by the original paper on the above subject has been so largely (in point of numbers, at least) antagonistic to the scheme, no doubt most of your readers are by this time of the opinion that there is no ground for further argument. But it is best to remember that, while any proposition of a radical and novel nature must of necessity be largely dependent for its support upon opinion, and battle against the facts of precedents, it does not follow that the heavy side of the argument is necessarily in the right. The author will not attempt to dispute what has been said against the scheme where the statements bear upon their face simply that of an opinion, because one man's opinion may be worth as much as another's, provided he has equal opportunities to obtain facts upon which to form an opinion, and is equally unprejudiced otherwise. The writer does not pretend to say that his forty-two years of work as apprentice, journeyman, foreman, draftsman, superintendent, instructor and proprietor, makes him superior, or even equal to others, but if a fair use of the opportunities for observation has been made, likely it is as good as it ever will be.

The scheme was the outgrowth of years of experience in teaching; years of observation since; the careful following of the result of his own work as a teacher upon the students; the result of the work of other teachers, and of the various technical schools of the country; the result of his own apprenticeship system, and the system followed by others within the range of his observations. Added to this is another opportunity not embraced by all men, and that is responding to the frequent application of proprietors for men to fill responsible and ordinary places, and the constant application from good men to find suitable places for them. So much in egotism as a statement of the basis upon which the original proposition was founded.

A half century ago, ministers, doctors, surgeons, school teachers and mechanics were men trained by the apprenticeship system. Is it not a fact that in all, except the last, the system has been superseded by the schools for special training. Whether the best ministers of to-day are better or poorer than the best of the old school, or whether the average of the old school was better than those of to-day, we do not know, but is it not a fact that the system has been changed? Is it not the same with the lawyers, doctors and teachers? Are they not now made up to the same point by the schools that they were by the apprenticeship system? The question in these things, as to whether they are better or worse, is entirely irrelevant to the question under discussion, because these things are the training of the intellect, and not of the hands, and the irrelevance is admitted; but what are the facts in the case as regards the surgeon? Will any one for a moment claim that the surgical student, whose only opportunity was the every-day practice of his superior, could possibly become as skillful as if he had had more opportunities for observation and practice in one year at the medical school or hospital, than he got in a lifetime through local practice?

It matters very little whether the school proposed be designated as a school, penitentiary or hospital; the fact ought to be apparent that facilities would be at hand where the pupil could have opportunities to learn more in a year than the average apprentice gets in three, and further, where it is the business of the man to give instruction, that he would be more likely to do it than where he is employed for another purpose, and when in many cases it is against his interest so to do.

It is not claimed that a mechanic of a lifetime's experience could be turned out in three years, nor that the same boy could learn more in one year, and be a better workman with one year's schooling than the same boy would be after a three years' apprenticeship, but what is claimed is this: That such a school could turn out boys at the end of three years that would be just as good workmen as the same boys would make if regularly apprenticed at the average shops after three years' service, and a good deal better men out of the same boys than if they were forced to run wild in the streets.

It is possible that, assuming, as was done, that the apprenticeship system had largely died out, that the conclusion was based on too limited knowledge, and that really, as one claims, the apprenticeship system fills the requirements. It may be, too, that the one conclusion was based upon too limited knowledge.

It may be that the apprenticeship system is the best. We are all liable to think that the way we acquired our experience was the best; the writer having been an apprentice himself, it is not easy to see why he would be more likely to under-estimate its value than others.

It may be, as some one wishes us to believe, that there is going to be no more use for skillful machinists, and that machine operators will operate machines to build machines for other operators to operate, and yet others may think there will still be a field for machine repairs where a certain kind of skill will be required, and it is possible that there may be still other new machines invented that will give employment to more good workmen than one visionary institution is liable to turn out. When machine construction and operation will have

become so perfect as to no longer require skilled mechanics, mankind will obey the commandments, ministers and churches be abolished, and sanitary science reach such a state of perfection that mankind will live on without doctors, and bones grow together without setting.

It is claimed by critics, and feared by others, that the proposed plan looks forward to the rich man's school. The writer does not see it in that light, or even in the remotest degree contemplates any such thing. The rich man sends his son to college, and yet all colleges are not rich men's colleges; at Cornell University a large minority are poor men's sons.

The poor man who has made his way in the world, and is determined to do better by his son than he fared himself, finds means to send him to the high school or academy, and why not to the industrial school?

At our colleges public-spirited citizens endow scholarships, whereby poor and worthy students receive help. The State gives large sums of money to promote education, general in public schools and special in the medical, law and normal schools, and the State has as much right to pay to help make the poor man's son a shoemaker as the rich man's son a lawyer. But before it is possible to acquire this aid, it has to be proven that it is desirable, that it can be accomplished, and this experimenting has got to be done, if done at all, by the rich man's money, and the experiment might as well be tried on the rich man's son, that is, if one sees fit to call the well-to-do citizen the rich man.

But there is another view of it, and this is the first time the writer has ever ventured the expression of the thought: Is it any worse for the poor man's son to go to the "eternal bow wows" than for the rich man's son, who the more often of the two carries down another with him?

There is a hint thrown out that the work would be of the prison labor sort, and, to use the common expression, "would take the bread out of the honest workman's mouth." It has never been the writer's misfortune to see an honest workman who ever feared honest competition. Plenty of men rail at the prison labor, who could not themselves do an honest day's work to save their souls, that is, according to others' ideas of what constitutes an honest day's work.

The idea is advanced that the result would be a class of dude mechanics. That is exactly what it would not be. The whole plan looks forward to turning out a set of thoroughly well-trained apprentices, who, while they have been acquiring the essentials of the trade, have gained such general knowledge as is likely to be of use to them through life, and many of whom might acquire that gift of all gifts—the learning how to learn. No one would spend any length of time in the place without getting value received, and those able to advance beyond the trade and general knowledge furnished by the institution would in no way be hindered or retarded, but fitted to go ahead.

Reference was made to the English premium apprenticeship system to show that people would pay the money. Mr. Booth shows that the premium apprenticeship is in bad repute, and that they all aim to something higher than machinists. That likely is true, but it does not prove that premium apprentices in an engineering establishment, where a few privileged boys, among a number of others not so privileged, are spoiled—it does not follow that where the whole school are equal, all will get the "big head" because they have to pay for their education.

It is not plain why the result of the Whitworth scholarship has any unfavorable bearing on the subject. Taking a good mechanic and giving him a technical education, the result that ought to be expected is that he seeks a position either where his technical knowledge will be paid for, or where he can make a living with less work, and so, too, take our boys who have no chance to do anything but laboring work, and give them a trade, and it is rather to be expected that they will work at that trade, rather than go back to ordinary day labor.

We are told that the author had better devote his time to improving the trades unions, if there is any room for improvement. It is one of the commonest of human traits, this saying what rich people ought to do with their spare money, or how those working for the general good ought to work. It is not probable that any of us will ever make much success of what we undertake, unless we have faith, and the writer has no faith in his ability to improve the trades unions. If any others thinks they can, the writer has not the least objection, nor will he ever suggest that they had better be turning their attention to something else. It is hoped, however, before they begin, they will try owning a shop, and have it run by the trades unions.

Radical as was the proposition to make the school the attachment to the shop instead of the shop an adjunct to the school, "Bell Crank" goes further, and questions the necessity or use of the school part altogether.

The author had thought that a pretty good knowledge of drawing, where a young man was in a position to get a comprehensive idea of the relation between the drawing and the thing itself, was rather desirable to have. Whether "Bell Crank" intends us to believe that drawing is not of enough use to the machinist to pay for the trouble, or that he can get what he needs at the public school, is not made clear; if the instruction at the public school is enough, all boys do not get it. There is something in applying mathematics in practice that puts a different phase upon it than is possible in the school-room.

In regard to lectures: There are three ways to learn how to do a thing. The best way to get at it and do it, the next to be told and the poorest to read about it. There are many things to be told and talked about and argued, which might as well be told to a hundred, all at once, as to each one separately, and the general discussion of a mechanical subject, or any subject that will cultivate the faculty of speaking in public, ought, if such a thing is desirable, be enough to justify the lecture-room attachment. These may be only the same things as the public schools furnish, still it is believed there will be found a great difference between the school training, where so much is assumed, and where the work, if properly managed, would show and be based, on the apparent fact.

Learning to make drawings and working out the drawings of something that is to be made; solving imaginary problems and figuring out some shop gear; copying letters from the ideal letter writer, and writing a letter on business; discussing a subject in debating school and arguing the case from the facts before you, are quite different things.

It has been pointed out in the discussion, that handicraft, both in skill and appreciation, has greatly fallen off since the days of the building of the old cathedrals. This is true, certainly, in the line of architecture at least, and lamentably so. Handicraft is still appreciated to a certain extent, but seldom, except when directed to the useless or ornamental. The sleight of hand performer, the juggler, the gymnast, whether in the ring or performing on the piano, receive as much pay and applause as ever, but it is deplorably true that handicraft, when applied to useful purposes, with perhaps the exception of the surgeon and optician, meets with but little appreciation and less reward. However, thought and sentiment, love, admiration and generosity, like the tide, like commerce, faith and finances, ebb and flow, and when the pendulum swings the other way, handicraft may again receive due appreciation and attain its proper place. The writer is not ashamed to admit, in fact, has the courage to say, that he hopes the time will come when man's worth will be measured by what he can do, and his use to the world, rather than by his birth, his money or his knowledge. This may never come; it may not be right that it should, and possibly one is inspired to express this hope from the same motive that leads aristocracy to claim the *right to rule*, that makes the wealthy claim that *money is king*, or the highly educated that *brains are supreme*.

JOHN E. SWEET.

He Refers to "Tom."

Editor American Machinist:

I have taken a good deal of interest in the way "Tom" has got out the work with but little to do with. It calls to my mind a job done when I was a "'prentice." A shaft came in 6 feet longer than the long lathe. The character of the job was such that the work must be done on the centers. The Old Man looked at the job an hour, then looked out of the window equally long; after he had gone, Bill and I went and looked out of the window to see what it was all about. We could see the old apple tree that had stood there from time immemorial. The next day the Old Man got Bill and I out with the log saw and cut the tree off at a level with the bed of the long lathe, then we put the tail-stock on the stump with long lag screws. Then the shaft was put in the lathe by putting the end out of the window and on to the tail center, and the job was done. Whether the firm charged the tree to the shop plant or the job I never knew.

I have a case I would like a verdict on. A tool maker makes a die, he being furnished with a draft with all sizes given. It is set in the press, tried, and the blanks pronounced correct by both the inspector and the foreman, but after 30,000 blanks were punched out an error of .005 is found in one of the holes (it is a compound die) rendering the work unfit for use. Error was not in draft. Was the tool maker responsible for any of the loss? If so, to what extent?

A. P. PRESS.

Conveniences in a Machine Shop.

Editor American Machinist:

I was much interested in "A Mechanic's" article, "Conveniences in a Machine Shop," in your issue of May 21.

While I am a firm believer in a sensitive drill, it is good in any shop, and among other things it is a good tool to use for drilling centers, but it is so handy for a great many purposes that when the latheman wants to drill his centers he is likely to find it in use for some other purpose. Then some one must wait.

I know it does not take long to change the sensitive drill for drilling centers, but in the same time the latheman could take out his lathe center and insert a chuck.

But rather than this, let each shop have a centering machine, of which there are some good ones; then a boy can do the job as well as a man. The work can be cut off and centered before the latheman needs it.

The tool-room question is always interesting. I think where a tool-room is lacking there is a great lack. Of course there are many good shops that have none, but if the expense of hunting up and fixing tools, and buying new ones unnecessarily, was reckoned, the tool-room would come out ahead. With a tool-room we know where things are, and that is just what we want to know. Then if a tool is broken it is repaired before some one requires it. This saves waiting for it.

I have tried several ways of keeping tools —"pigeon-holes," "wall rack," "revolving rack," a stand of shelves, etc.—and prefer the inclined wall rack, as being the most convenient and requiring the least room. Common mandrels are usually from 20 inches down in length. In pigeon-holes, a mandrel 20 inches long would require floor space of 20 inches one way, while the wall rack would require but 6 inches. (The rack should be made with the bottom but 6 inches out from the wall.) The heavier tools in the lower rack and the next rack above should extend half way down over the lower rack, and so on; this economizes space. I find that more tools can be stored in a given space by this plan than by any other, and anything that does not belong in the rack will not get pushed back out of sight. The tools will always be in sight, and being marked, no marking of the racks will be required.

I think it good practice to have a good lathe and an emery grinder in the tool-room; also, a good workman. I count a loss of $500 a year for every twelve men employed on general work where there is no tool-room. Where the work is special the loss is not so great, but then it is too great to be tolerated. H. F. S.

Another "Wobblegear."

Editor American Machinist:

Tell Uncle Ben that old Wobblegear isn't dead yet; it wasn't very long ago that the foreman of an electric manufacturing company was showing me how nice the regulation of his dynamo was; and it was nice, too; he jumped from one light to fifty, and back again, without a flicker, and when I asked him how it was accomplished, he looked very wise, and said that it was all in the way the machine was wound, and *that it was a secret.* W. L. CHENEY.

Computing Change Gears.

Editor American Machinist:

I was interested in George B. Grant's article, "Finding Change Gears for Odd Pitches," in the AMERICAN MACHINIST, April 9th. I figured for the gears in the following manner: first finding how many threads there was to the inch by ÷ 47 by $12.37 = 3.799$, being so near to 3.8 within one thousandth, we can practically call it so. $3\frac{8}{10} = 3\frac{4}{5} = \frac{38}{10}$ pitch; dividing $\frac{38}{10}$ pitch by $\frac{4}{1}$ pitch of lead screw we get $\frac{5}{10} \times \frac{7}{1} = \frac{35}{10}$, the required gears. Proof: $19 \times 7 \div 35 = 3\frac{4}{5}$. EDWARD D. GLEASON.

The firm of religious publishers that has just been robbed of thousands of dollars by a clerk whose salary was $14 a week, is probably satisfied that the Elmira Reformatory is the best place for the young husband and father whom they have driven through poverty to forgery. But the public, and especially the readers of the *Churchman*, may well ask whether the Elmira institution ought not to establish a department for reforming the consciences of employers who asks heads of families to work for $700 a year. The story told in yesterday's *Commercial* is discreditable to others, as well as to the young man who has confessed his crime. Theatrical ventures and stock speculations are bad enough, but when the reverend editor of a religious newspaper, with an income of many thousands a year, can only spare $14 a week to his head bookkeeper, he must expect no more sympathy for his losses by theft than for such as he might suffer by gambling.—*Commercial Advertiser.*

At the Massachusetts Institute of Technology they use, in connection with lectures on machine tools, steam engines and other machinery, paper-covered books, in which are printed illustrations of typical machines of the character under discussion. The illustrations are such as are used in the catalogues of the manufacturers and in technical journals, many of them having appeared in our columns; but the grouping of them in classes, so that peculiarities of design can be readily studied and compared, makes the books very valuable to those interested in such matters, and it is a plan which must afford a very great deal of help in the systematic study of designs by the students of the institute. The illustrations are selected and the book arranged by Prof. C. H. Peabody.

By the death of Mr. Frank Cook the mechanical world has lost a young man who seemed destined to become one of its brightest lights. He formerly resided in Springfield, Ohio, where his father is a pattern maker. Frank became a draftsman in one of the large establishments there, and designed, among other things, an automatic nut-tapping machine, which was a highly creditable piece of work. For some time past he had been with the Capitol Manufacturing Company, of Chicago, where he was engaged in perfecting this nut tapper and other automatic machinery. At the time of his death, which resulted from typhoid fever, he was 27 years old.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, postage paid.

DEALERS SUPPLIED BY

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The Williamsburgh News Co., Brooklyn, E. D., N. Y.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne,

NEW YORK, JUNE 25, 1891.

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"Phenomenal Friction."

Some time ago we noticed in the *Franklin Institute Journal* an article entitled Phenomenal Friction, by John H. Cooper, and wondered at the time why a phenomenon that must have been noticed a great many times by nearly every mechanic should be considered remarkable or mysterious, as this evidently was by the author, and presumably the publication committee. The gist of the article was that a box being used in a Thurston testing machine, which could not be moved endwise on the spindle by a man exerting his full strength, with the spindle standing still, was moved endwise by the application of a force of six ounces, when the spindle was running. We are more than ever surprised to find this article reprinted far and wide in both foreign and home journals, mostly without comment to show that it is regarded in any other light than as a curious and newly discovered phenomenon. Yet every machinist who has done any polishing in the lathe is familiar with it, and so also are those who have ever moved a pulley along on a shaft where the fit was close. Polishing clamps that cannot be moved at all with the work standing are easily moved when it runs, and a pulley which could scarcely be moved along a shaft by a sledge hammer may be easily moved by the hands, if turned about the shaft at the same time. The reason for this is that, by taking hold of the rim of the pulley, a leverage is obtained by which to overcome the friction between the bore of pulley and shaft, and then, if at the same time a sidewise pull is given, the direction of motion is the resultant of the two forces acting simultaneously, and the principle is that of the familiar composition of forces. It is a rule, moreover, that works both ways, and we have seen practical use made of this fact in railroad shops, where, when it becomes necessary to turn a driving wheel center slightly on the axle, it can easily be done by jacking the wheel to clear the rail slightly, and placing it so that the counterweight will tend to turn the wheel in the proper direction. Then a portable hydraulic press is used to move the wheel endwise on the shaft, and when it is thus moved the weight of the counterbalance easily turns it upon the axle, though as much as 60 tons are required to move it endwise.

Mr. Cooper says that numerous applications of this principle will readily suggest themselves, and mentions planer platens, which may be moved along the bed much more easily, if resting upon shafts running lengthwise along the bed on each side, the bed and platen being fitted to them. This, no doubt, would be true enough, but when the power required to turn the shafts was added to that required to move the platen, we imagine the gain would be a minus quantity. It would be a case of robbing Peter to pay Paul.

Friction of Nuts.

At this writing (previous to the Providence meeting of the engineers) we cannot say what will be the nature of the discussion called out by Mr. McBride's paper, published in another column of this issue, entitled, "Some Experiments with a Screw Bolt," but the most evident point in connection with it, it seems to us, is that the experiment is wholly inadequate as a foundation upon which to base estimates of friction of rough nuts when turned upon bolts by a wrench, or an attack upon the text-books for being "painfully silent on this subject," and leaving the reader "in a very uncertain frame of mind as to how much to allow for this element of resistance."

When a bolt is turned true, with a true thread cut upon it in the lathe, and the nut is faced true and smooth, and bears upon a smooth and true surface, we have conditions which can be practically reproduced at any time, and may expect, from any number of experiments made under such conditions, practically the same results, and a carefully conducted experiment with one such bolt and nut would readily be taken as fairly representative of what might be expected with all others.

But with a bolt cut by dies in a bolt-threading machine, and an unfaced nut and rough washer, the case is entirely different. We all know that the threads on such bolts are likely to be "drunken," and that, while some nuts may be nearly square, so that a fairly good bearing may be obtained, others may be far from square, and, having a bearing on one side only, not only increase the pressure upon that side to the point of adhesion between the nut and washer, but also greatly increase the friction of the threads by "cramping."

We should consider that ten bolts and nuts to experiment upon would be the very least number upon which to base the average friction that might be expected under such circumstances, and twenty-five or even fifty would be still better.

Mr. McBride found in his experiments that practically 90 per cent. of the force applied at the wrench was used up in friction. This may happen to represent about the average friction for rough bolts and nuts. Of authorities quoted by him, those who give figures for the friction place it at 66 per cent. to 91 per cent. This is probably for true threads and faced nuts, and for different loads, from moderate ones to the heaviest, the friction probably actually varying to that extent.

A comprehensive series of experiments to show the friction of nuts and bolts are much to be desired, and we hope that Mr. McBride or some one else will make them and give us the results.

Jet Propulsion.

Those who feel interested in the matter can, if they choose, easily trace the relation between the results of experiments in jet propulsion, detailed on another page of this issue, and the experiments of Dr. Jackson with his vessels, driven by means of small jets, using high pressures.

According to our understanding of Jackson's theory, the expected efficiency of his jets depended mainly upon the resistance to motion offered by the external water surrounding the jets—its inertia, so to speak.

The experiments made by Mr. Everett make it more than ever clear, we think, that this principle does not apply to jet propulsion at all, but that the tendency of a boat to move forward by the action of a jet is due simply to the reaction resulting from giving motion to the water in the opposite direction.

There is another point in this connection not shown by the experiments, but which is suggested by it, and that is, that really the reaction of the nozzle will be less, the deeper it is immersed, so long as the pressure within the nozzle remains the same. This becomes clear when we consider what would happen were the nozzle carrying 100 pounds pressure, immersed to a depth of 230.4 feet. At this depth the external pressure of water would just equal that of the jet, and there would be neither action nor reaction.

This, of course, is independent of the further fact that a pressure of 100 pounds above the external pressure would, theoretically, be as easily maintained at 230 feet depth as near the surface.

There is nothing that promises more good in a mechanical way in this country than the very general association of men of kindred occupations. The associations of mechanical engineers, of boiler makers, of stationary engineers and others are surely doing good work. We are hardly as yet up to European practice in this respect, but we are getting there pretty fast.

A correspondent writes us: "I want to enter a protest against the habit that men have of trying, in setting forth the merits of their own manufacture, to belittle what others do. I don't believe it helps the case a bit; on the contrary, I believe it prejudices it. When I read a circular I want to find out what a given machine will do; not what some other machine will not do."

A Proposed Systematic Study of Taxation.

There is a growing conviction that there are many features of our American system of taxation that are, to say the least of it, capable of being improved. Those who are earning what they receive by any kind of honest endeavor are becoming convinced that taxes are so levied as to bear more heavily upon them than upon those who do nothing or next to nothing that is of the least use to anybody. In fact, it is apparent, as we have shown in these columns from time to time, that some features of our tax laws are so arranged as to operate directly to discourage any kind of enterprise or work that would be of benefit to mankind, while encouraging mere speculation that benefits no one but the speculator.

But when tax laws are to be changed, action should be based upon intelligent knowledge of the principles of taxation, and this can, of course, be best acquired by study and discussion carried on by citizens independent of partisan politics. All good citizens will therefore welcome the formation of such an organization as the New York Tax Reform Association, an advance copy of whose principles we have just received. Its object is to discuss and educate with a view to securing intelligent legislation in response to an intelligent popular demand.

Among the principles of the Association we find the following: "The most direct taxation is theoretically the best, because it gives to real payers of taxes a conscious and direct pecuniary interest in honest and economical government. Mortgages and capital engaged in production or trade should be exempt from taxation, because taxes on such capital tend to drive it away, to put a premium on dishonesty, and to discourage industry. Real estate should bear the main burden of taxation, because such taxes can be most easily, cheaply and certainly collected."

Any movement in the direction indicated by these principles can but be of special interest to manufacturers and mechanics, and it behooves them to give some attention to the arguments upon which they rest, in order that their influence may be felt in accordance with their convictions on the subject, whether for or against them. As the association says, "Spasmodic and unreflecting tinkering with it [the present system of taxation] is unlikely to result in substantial improvement."

It is worthy of note that the names of some heavy real estate owners are appended to the principles as issued, including the present and an ex-president of the New York Real Estate Exchange, but these men are, we believe, in every instance active men of affairs as well, who know that progress (and, ultimately, the value of real estate) depend upon work of some kind, and believe that some of our tax laws stand in the way of useful work.

Literary Notes.

COMPRESSED AIR PRODUCTION. Rules, Tables and Illustrations relating to the Theory and Practice of Air Compression, and Compressed Air Compression. The Best Practice in Europe and America Compared. By William L. Saunders, M. Am. Soc. C. E.

Mr. Saunders has made a special study of the question of air compression, and is recognized as an authority. The pamphlet before us is a reprint of a lecture delivered before the students of Sibley College, Cornell University, by invitation of its director. Though the pamphlet is a small one, into it has been compressed a great deal of valuable information regarding the theory and practice of air compression, and it is a publication which will be welcomed by engineers generally. It is shown conclusively by facts and figures that, though the plan of cooling the air by water injection, as practiced abroad, has been abandoned in this country, yet the total efficiency of the best American machines is practically as high, because friction is very much further reduced, while the machine is much more simple in construction. The total efficiency of the best European machines is given as

84 per cent., while that of the American machines is 83.5 per cent. Engineering News Publishing Co., New York. Price, 50 cents.

THE ELEMENTS OF DYNAMIC ELECTRICITY AND MAGNETISM. By Philip Atkinson, A. M., Ph. D., author of "Elements of Static Electricity," and "The Elements of Electric Lighting."

This book was written for learners, comprising those who have a good education, and students who intend to become electrical engineers, to whom a thorough knowledge of elementary, physical, electric principles is important as a preparation for a more extended mathematical course. The book contains thirteen chapters, treating on the voltaic battery; one-fluid cells; two-fluid cells; battery formations; magnetism-electro-magnetism; electric measurement; the dynamo and motor; electrolysis; electric storage; the relations of electricity to heat; the relations of electricity to light; the electric telegraph; the telephone. Each chapter is intended to be a complete treatise on the subject to which it relates, and the whole thirteen to embrace all the essential facts pertaining to that form of electricity which manifests itself in currents, as distinct from the form known as static. Mathematical reasoning, where required in the author's opinion, has been reduced, as far as possible, to ordinary language, intelligible to unmathematical readers. This is an excellent book, and no earnest and attentive, liberally educated person who desires to extend his knowledge of electric principles can fail to do so. But there will undoubtedly be a class of readers who will need more elementary works treating on this subject, before they can master this book. It is published by D. Nan Nostrand Company, 23 Murray and 27 Warren streets, New York. Price, $2.

Key to Steam Engineering is the title of a neat little handbook of 90 pages, issued by the Mason Regulator Co., manufacturers of steam-regulating specialties, 10 Central street, Boston, Mass. This is an excellent little book, written in the simplest language possible, and the computations are given in their simplest form, making the book extremely valuable to the practical engineer who cannot comprehend other works of a more technical character. The book is divided into two parts; the first treats on air, water, fuel, steam, boilers, engines, belts and shafting, speed of pulleys, etc., and contains tables. This part of the work is composed of short questions and answers, such as are likely to arise in the mind of an intelligent and practical engineer. Part Second treats on the combustion of coal, chemically and practically considered. It is written in an interesting manner, and a careful study of the subject, as it is here presented, cannot fail to be of benefit to those who wish to become familiar with the nature of combustion.

The book does not contain any advertisements; in fact, not once of the steam-regulating specialties made by the company is once mentioned; but it is full of interesting and profitable matter for steam engineers, and it is worth more than the price asked. It is sent out by the Mason Regulator Company for 30 cents.

MECHANICS' PRACTICAL REFERENCE BOOK. Containing Mathematical and Geometrical Rules and Tables.

This little paper-covered pocket-book of 43 pages contains ordinary simple rules in arithmetic and mensuration, such as may sometimes be forgotten. Besides these, it contains a few useful tables which will be of service by keeping them conveniently at hand. All these rules and tables are compiled in a very handy form, making a small book well adapted for reference, but covering comparatively a small field. It is published by Summit Publishing Co., Akron, Ohio. Price, 15 cents.

No. 5 of *The Technograph*, which is published by the Civil Engineers' Club and the Mechanical Engineers' Society of the University of Illinois, is well supplied with valuable and interesting matter on a variety of subjects relating to civil and mechanical engineering, and all of a practical nature. Its price is 50 cents.

Mr. Wm. Lodge, of the Lodge & Davis Machine Tool Company, Cincinnati, and Mr. P. E. Montanus, of the Springfield (Ohio) Machine Tool Company, called at this office a few days ago on their way to Europe, where they go, partly for recreation and pleasure, and partly to attend to matters in connection with export trade in machine tools.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(281) W. G. R., Boston, Mass., writes: Please advise me through your columns what the best rule is for finding the horse-power of high-speed engines, both compound and single. *A.*—See answer to Question 428, in our issue of November 6, 1890.

(282) W. S., Brooklyn, N. Y., writes: Kindly inform me what style of an engine to use for a flat bottom boat 13 feet long, 4 feet wide? *A.*—A flat bottom boat is not a suitable one for an engine, but if you insist to put one in, an upright engine with cylinder 1¾ inch diameter, and 2½-inch stroke, will be as good as any other. 2. Please state price. *A.*—The price you will obtain from any manufacturer of engines.

(283) W. R., Chicago, Ill., writes: Please state the horse-power of a boiler 14 feet long, 52 inches diameter, with 44 flues, 3½ inches diameter. *A.*—Allowing 15 square feet of heating surface per horse-power, we should rate it at 46 horse-power. 2. What is the horse-power of a plain slide valve engine, cylinder 11x15 inches, running at 132 revolutions, with 60 pounds steam pressure? *A.*—27 indicated horse-power.

(284) Reader, New York, writes: Would you please state what relative increase of power will be required to double the speed of the wheel, or fan, of a centrifugal pump? *A.*—The increase of power will depend on the construction of the pump; it is not the same for the different types of pump. We should advise you to write to the manufacturers for catalogues; these generally give the power required.

(285) G. F. W., Portland, Oregon, asks: About what is the indicated horse-power of a compound condensing engine of the following dimensions: High-pressure cylinder, 3 inches diameter; low-pressure cylinder, 6 inches diameter; stroke, 5 inches; steam pressure, 100 pounds; cut-off in high-pressure cylinder at ¾; number of revolutions, 400 per minute? *A.*—We should rate it at 14 indicated horse-power. 2. How much heating surface will I require in the boiler? *A.*—About 150 square feet.

(286) R. K., New Castle, Pa., writes: Please give me the name of book, and where it can be obtained, treating on stationary engines, giving description and cuts of different types, and methods of building engines, and formulas that are essential in engine building. *A.*—Descriptive Treatise on Constructive Steam Engineering, by J. M. Whitham, M. E., C. E. The formulas are given in Steam Engine Design, by the same author. Both books are published by John Wiley & Sons, 53 East Tenth street, New York.

(287) B. R., Drammen, Norway, writes; Please inform me if you know of any ice breakers being used employing circular saws for cutting the ice. If not, have any attempts been made in that direction, and what was the principal failure of such an attempt. Where can I obtain information on this subject? *A.*—We have seen circular saws used for cutting ice, but we cannot say whether this mode of cutting ice is as satisfactory as other methods. We do not remember the maker of this machine, and we do not know of any books which treat on this subject. Probably some of our readers may give us some of their experience in cutting ice by machinery.

(288) W. H. W., Millerstown, Pa., writes: Please state what the Atlantic cable is covered with. Is it coated with rubber, or what are the chemicals employed in making it? I wish to make some experiments on something that will take the place of leather cups in suction pumps exposed to the action of salt water. Can you suggest something that will be as pliable as rubber, and tough to stand the wear? *A.*—The core of the Atlantic cable laid in 1866 is protected first by a stout layer of gutta-percha, then by a woven coating of jute, and outside of all an external sheath made of ten iron wires, each covered with hemp. The shore ends are more strongly protected by external wires. We cannot suggest anything better than leather.

(289) G. M., New York, writes: In your answer to Question 70, relating to columns, the last formula reads

$$P = \frac{36{,}000}{1 + \frac{l^2}{3{,}000\ b^2}}.$$

It seems to me that the omission of A is incorrect. And in the first formula for solid pillars there is evidently a misprint; instead of l_2 it should read l^2. *A.*—We thank you for drawing our attention to the errors. The letter A should not have been omitted; and l^2 should have been used instead of l_2. 2. I understand that the last two formulas are for square pillars, as b represents a side; am I right? *A.*—Yes.

(290) R. C. B., Torrington, Conn., writes: We have an iron smoke stack which has been in use but three years, and has corroded to such an extent as to compel us to replace it by a new one. Is there anything that we can coat the inside with to make it last longer? We use nothing but soft coal. *A.*—Dixon's silica graphite paint is often used for this purpose, and, it is said, with good results. If this should fail to overcome the corroding, we should advise to line the stack with fire brick from 2½ to 4½ inches thick, according to size of stack. If the stack is over 5 feet diameter, the lining should be 9 inches thick for about one-third of its whole height, and 4½ inches thick the remaining distance. There should be a layer of fire clay between the brick lining and the metal sheet. This lining will, of course, reduce the cross-sectional area of the stack, and, therefore, allowance for the lining should be made in designing a new stack.

(291) T. W. R., Perth Amboy, N. J., writes: Please inform me how to proceed to learn mechanical drawing without a teacher; and how I can become familiar with the mechanism and use of lathes, milling, drilling, slotting and screw-cutting machines and other tools used in a machine shop. Also state what other sciences are necessary for me to study to become a thorough machinist and mechanical draftsman. I am at present employed as an apprentice in a drawing-room of a large manufacturing company, but I have few opportunities of studying the above-named machines, having plenty to do with the work relating to the special machines which are manufactured by the company. *A.*—To learn drawing we should advise you to study the articles on Practical Drawing recently completed in the AMERICAN MACHINIST. Close observation, experience, in addition to a close attention to descriptions of machinists' tools and other matter in technical journals will enable you to become familiar with these tools and their uses. For the study to be pursued so as to become a thorough machinist and draftsman we must refer you to our issue of February 19, page 4, current volume.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 30.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

N. Y. City Bolt & Nut Co., Limited.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 112 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Milling Machines. Pedrick & Ayer, Philadelphia, Pa.

Universal Grinding Machine. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

One Star Hack Saw will cut steel a whole day without filing.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Audubon Machine Works, New Haven, Conn. Electrical work, superior facilities. Builders of machinery, heavy and light.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves, T. Kieley, 11 W. 13th St., N. Y. Send for des'n

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

Self-adjusting Hand-Screw for pattern makers, cabinet makers and wood workers generally. Send for circular. Wm. H. Denney, Lancaster, Pa.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Our catalogue of books on all subjects, including books for machinists and engineers, sent free. Norman W. Henley & Co., 150 Nassau St., N. Y.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } even if they come from Jersey."
42" } Gould & Eberhardt, Newark, N. J.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau street, New York.
Send for Brief History of Patent Legislation.

Foot and Power Presses for Metal, Paper and Leather. Perforating Dies a specialty. Estimates given for special machines or dies. Edwin B. Stimpson & Son, Manufacturers, 31 Spruce St., New York.

Hawkins' Calculations for Engineers, Firemen and Steam Users can be ordered through the news companies in 10 parts; 25 cents each, or in one bound volume, $2.50. Theo. Audel & Co., publishers, 91 Liberty Street. Catalogue free.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations 8vo., cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES.

Another cotton-mill is reported as to be established at Newton, N. C.

Cox & Morrison are to build a new boiler-making plant at Wheeling, W. Va.

The Western Iron Company, of Kansas City, Mo., is to remove to Kenilworth, Mo.

The Murray Metallic Packing Company has been incorporated, at Albany, N. Y.

The Jonesboro (Tenn.) Cotton-mill will double its capacity in the fall, it is reported.

New machinery is to be added to the Packard Lamp Company's plant at Warren, Ohio.

A machine shop 108x40 feet is in course of erection, at Barre, Vt., by Whitcomb Brothers.

New machinery is to be added to the Shoe and Leather Company's shop at Fort Worth, Tex.

A. J. Nanquin will, it is reported, erect an iron foundry and machine shop at Orange, Texas.

Jackson Brothers will erect a foundry and machine shop, 100x40 feet, at Hillsborough, N. H.

The erection of a foundry and machine shop is contemplated by Lewis Miller, at Chester, Pa.

J. B. Barrett & Co. will probably erect an iron foundry and machine shop at Wytheville, Va.

McColl, S. C., is to have a cotton factory, a stock company for the purpose having been organized.

The Nashville (Tenn.) Woolen Manufacturing Company contemplates the addition of machinery.

A stock company will probably be organized to establish a builders' hardware factory in Wheeling, W. Va.

The Standard Nut Lock Company has been incorporated, at Detroit, Mich., with a capital of $100,000.

The Stanly Manufacturing Company has been organized, at Bilesville, N. C., with a capital stock of $25,000.

Articles of incorporation have been applied for by the Montreal (P. Q.) Metal Company, capitalized at $50,000.

It is reported that an English syndicate has contracted for the erection of an iron furnace at Queen City, Texas.

The Industrial Iron Works, of Bay City, Mich., are preparing to build an addition, 255x90 feet, to their works

The Southwestern Steel Post Company, of East St. Louis, has been incorporated, with a capital stock of $500,000, by A. B. Bennett, H. Pope and W. P. Clarkson.

The Industrial Iron Works, at Bay City, Mich., are preparing to build an addition, 225x90 feet, to their works.

Negotiations are now pending for a new steel plant to be erected at Mendelssohn, in the Monongahela Valley.

The Minneapolis Rolling-mill Company is the name of a new concern recently organized at Minneapolis, Minn.

The old Spaulding nail-mill, at Brilliant, Ohio, is to be transformed into a bar-mill. The work is now in progress.

The Nashville Woolen Manufacturing Company, Nashville, Tenn., will put some more machinery in their mill shortly.

C. E. Fink contemplates the organization of a stock company to erect an electric light plant at Westminster, Md

A Schenectady (N. Y.) firm are arranging to erect a foundry, at Lansingburgh, N. Y., which will employ about 100 men.

The firm of E. Broad & Co., manufacturers of edge tools, of St. Stephen, N. B., is to be organized as a stock company.

The Marion (S. C.) Cotton-mills Company will, it is reported, increase its capital stock and the capacity of its cotton-mill.

The Hendrick Manufacturing Company, of Carbondale, Pa., have broken ground for a new machine shop 140x40 feet.

A proposition has been made for the organization of a stock company to erect a new electric light plant in Charleston, S. C.

Mason, Ford & Co. are reported as having bought the $100,000 pump works of the Metcalf Manufacturing Co., Eddyville, Ky.

The capacity of the Nanaimo Foundry Company's plant at Nanaimo, B. C., is to be increased by the addition of new machinery.

A steel plant is contemplated at Strasburg, Va., by W. G. Carroll, who, it is reported, has leased land with that end in view.

Eastern capitalists are endeavoring to organize a stock company for the erection of a new electric light plant in El Paso, Texas.

J. H. Kruse will rebuild at once his plumbing, tinners' and light machinery shop, at De Funiak Springs, Fla., recently burned.

The Hill Machine Company, Florence, Mass., will erect a brick pattern house, which will be 50x25 feet, 12 feet high, and fire-proof.

The Noyes & Nutter Manufacturing Company, Bangor, Me., are erecting a new foundry building at that place, at a cost of $6,000.

The organization of a stock company to erect an ice factory is talked of at Arkansas City, Ark. J. W. Dickinson, Jr., can give information.

The Bailey Farrel Manufacturing Company, of Pittsburgh, Pa., with a capital stock of $300,000, was granted a charter on the 3d inst.

J. C. Cary is endeavoring to organize a $250,000 stock company for the purpose of erecting a cotton-mill on Little River, near Seneca, S. C.

The Royal Bridge and Iron Co. (Montreal, Can.,) has been incorporated, with a capital stock of $30,000, to manufacture steel and iron bridges, etc.

The Edes Mixter & Heald Zinc Company, Mosey Creek, Tenn., is reported as putting new machinery in and increasing the capacity of its zinc works.

The Marshallville Manufacturing & Improvement Company contemplates the erection of an iron foundry and machine shops at Marshallville, Ga.

A movement is on foot at Scranton, Pa., to build a wire drawing plant and nail factory. James Nolan is mentioned as the originator of the enterprise.

L. Schutte & Co. are to erect a factory and machine shop at Philadelphia, Pa. The building is to be 80 feet square and six stories high, with a basement.

The capacity of the plant of the Merchants' Manufacturing Company, of Fall River, Mass., is to be increased by the addition of a number of new boilers.

The J. L. Perry Machine Company, of Chicago, Ill., has been incorporated, with a capital stock of $100,000, by W. S. Hoffman, J. P. McCourty and G. W. Kolb.

The contract for building the machine shops of the Norfolk & Western Railroad Company, at Shenandoah, Va., has been awarded. The amount is $50,000.

At a recent meeting of the stockholders of the Hanover Foundry and Machine Company at York, Pa., $40,000 was subscribed for the erection of a new structure.

The Drummond-McCall Pipe Foundry Co., Montreal, Canada, has been incorporated, with a capital stock of $50,000, for the manufacture of water and gas pipe, etc.

Fort Erie, Ont., is to have a plant for the manufacture of tin goods. F. G. O'Ehle is the chief instigator of the cause, and promises to push matters as much as possible.

The Willis Manufacturing Company, at Galesburg, Ill., has been incorporated, with a capital stock of $10,000, to manufacture sheet work and galvanized iron cornices.

The Acme Water Lift Co. has been incorporated, at Jacksonville, Fla., with an authorized capital stock of $25,000 to manufacture the Acme water lift and other machinery.

A stock company will, it is reported, be organized, at Grover, N. C., for the purpose of erecting a cotton-mill. N. B. Smith, of Clover, S. C., can probably give information.

At Orlando, Fla., the South Florida Foundry and Machine Works will soon put in an outfit for the manufacture of tubular boilers, and is now in the market for suitable machinery.

It is reported from Omaha that a large new machine shop will be built by the Union Pacific at that point, considerably larger than the combined capacity of the shops now located there.

It is reported that a Pittsburgh (Pa.) firm has leased the old Gephart foundry and machine shops, at Cumberland, Md., and will put the plant in operation for the manufacture of electrical supplies.

The Malleable Iron Works at Chattanooga, Tenn., have started up. The works have been in course of construction for nearly a year. They cost $75,000, and will give employment to 100 men.

It is announced that a plant for the manufacture of iron and steel on a large scale will be erected, at Harrisburg, Pa., within the next six months. The enterprise is projected entirely by local capitalists.

The E. D. Swift Powder and Cartridge Manufacturing Company has made a proposition to establish a $200,000 cartridge and powder factory in Farmville, Va., provided the citizens subscribe $50,000.

The Nickel Steel Co. has been organized, and have made application to the Ontario Government for a charter. The company intend to erect smelting works at a point on the north shore of Lake Huron.

A charter has just been issued to the Cotton Shoals Electric Light and Power Company, of Graniteville, S. C. Directors, Alvin Ethridge and W. A. Edwards; capital stock, $10,000, in shares of $50 each.

An order has already been placed for a portion of the machinery for the Jefferson (Tex.) $1,000,000 steel plant. Expert engineers have been employed to arrange all details of plans for the construction of the works.

Curtin & Hebert, of Gloversville, N. Y., write us that their new shops, referred to in our issue of June 11, will be erected at Gloversville. They expect to manufacture special sewing machines for use in making gloves.

The Stearns-Roger Manufacturing Company has been incorporated in Denver, Colo., with a capital of $250,000, to take over the business of Stearns, Roger & Co., manufacturers of mining machinery, with works at Pueblo.

Pittsburgh (Pa.) Chicago (Ill.) and Tennessee capitalists are reported as organizing a stock company to construct a steel plant at South Pittsburgh, Tenn. The South Pittsburgh City Co. can probably give information.

The Canton Foundry Company, of Canton, Ohio, have purchased a site at Hammond, Ind., to which they propose to transfer their works. The land lies north of the Grand Calumet River, within 20 miles of the center of Chicago.

The new shops for the Morton Manufacturing Company, of Romeo, are ready for occupancy. They are located at Muskegon, Mich., and were donated the company by the citizens of that place. The plant was erected at a cost of about $30,000.

In the event of the sale of the franchises and property of the Baltimore City Passenger Railway Company, Baltimore, Md., now being negotiated, several power plants to operate the lines by cable will doubtless be built. Bernard Cahn can give particulars.

The Southern Farm Tool Company has been incorporated, at Atlanta, Ga., by Thomas Lumpkin, A. M. Hipps and others. Capital stock, $100,000, and the business to be carried on is the manufacture and sale of machinery and agricultural implements.

The North Avenue Electric Railway Company, of Baltimore, Md., will probably soon commence the erection of its electric power plant at North and Slingluff avenues. The plant is to include two 125 horse-power engines, and two 80,000 Watts generators.

The Lownes Manufacturing Company, Huntsville, Ala., is a new concern that will engage in the manufacture of Lownes patent pipe and combination wrenches. The Lodge & Davis Machine Tool Co., Cincinnati, Ohio, have sold them a complete outfit of machine tools.

The details of the removal of the South Boston Iron Works from South Boston, Mass., to Middlesborough, Ky., have been completed, and work upon the buildings commenced. The company will have a paid-up capital of nearly $600,000, and will employ about 500 men.

The Harriman Manufacturing Company is reported as having closed negotiations with the Bailey Auger Bit Company, of Lancaster, Ohio, for the removal of its auger bit works to Harriman, Tenn., where the company will reorganize, with a capital stock of $50,000.

We are informed that the Hoppes live steam feed-water heater and purifier, under test for six months by the Minneapolis water-works, for keeping the boilers clean and free from scale, has been accepted, the chief engineer reporting that its operation was entirely satisfactory.

The Atlanta Iron and Steel Casting Company, recently organized at Atlanta, Ga., with a capital stock of $150,000, for the manufacture of malleable castings, has elected Edward Van Winkle president; H. L. Atwater, vice-president; A. R. Bryan, secretary, and W. H. Trezevant, treasurer.

The Iowa Iron Works Company, of Dubuque, Ia., is talking of removing to St. Louis, Mo. It desires a good location, with an extensive water front for the accommodation of the boat-building business, which is its chief occupation. About 300 hands will be employed when the plant is in operation.

An Ohio party is corresponding with the Big Stone Gap (Va.) Improvement Co. relative to the establishment of a shoe factory, foundry and machine shops, rolling-mill, electrical works, iron works, planing-mill and sash, door and blind factory, two glass factories and other manufacturing industries.

A proposition has been received by the Mercantile and Manufacturers' Bureau, of Denver, Col., looking to the location of a nail factory in that city. An Ohio manufacturer proposes to establish a plant with a capital of $35,000. He will employ about 30 men, and expects to manufacture 50,000 kegs of nails annually.

The Canda Manufacturing Company has been incorporated at Carteret, N. J., with capital stock of $1,000,000 for the manufacture and sale of railway equipment or leasing of the same. The stockholders of the company are: C. J. Canda and J. W. Savin, of New York City; C. P. Haughians, Brooklyn, N. Y.; E. S. Savage, Woodbridge, N. J.

Work on the new buildings to be occupied by Jos F. Wangler's boiler making plant, at St. Louis, Mo., is being pushed with great vigor. The old plant is being torn away piece by piece to hurry the improvements being made in that vicinity, and the new quarters will be occupied just as soon as they will afford shelter to the machinery and men.

An agreement between the city of London, Ontario, and the Grand Trunk to give the company $100,000 bonus for maintaining their principal car shops west of Toronto there, has passed the city council on condition of $150,000 being expended on the work and 500 men employed. The question of a bonus will have to be submitted to the people for a vote.

The Eureka Tempered Copper Company, of North East, Pennsylvania, on account of its largely increasing business, has found it necessary to enlarge its plant, and is now laying the foundation for a new molding room 50x140 feet, hoping that the increased facilities which this addition will afford may enable it to meet the increasing demand for tempered copper.

The Cumberland and Unaka Iron and Steel Company, recently incorporated at Knoxville, Tenn., has organized, with J. L. Murphy, president; David Getaz, vice-president, and W. R. Murphy, secretary. This company's purpose is to control the Conley process of making steel, and it is reported that a local company will be organized at once to erect a plant at Knoxville.

The new safe and lock works which are to be erected at Elizabeth, Pa., has been duly organized, with a capital stock of $200,000. They elected J. R. Wylie as treasurer, and C. H. Underwood, E. W. Neff, J. T. Hough, J. B. Sherriff, Jas. H. Graham, W. C. Voigt, and John Collier as directors. The company will be known as the American Vault, Safe and Lock Company.

The Brilliant Iron and Steel Co., of Brilliant, Ohio, will commence at once upon a new department in the old Brilliant nail works. The old plate-mill and a part of the nail factory will be torn out, and two merchant bar-mills will be put in their places. The company has decided to abandon the manufacture of nails almost entirely, and will change the plant into a sheet and bar mill.

It is reported that the South Pittsburg (Tenn.) Pipe Works will increase its capital stock from $100,000 to $200,000, the additional capital to be invested in a steel plant of the basic process. It is proposed to build two converters of 20 tons capacity each, the buildings to be of brick and iron, 80x150 feet. Work is to commence within a few weeks. George E. Downing, general manager, can give particulars.

The managers of the Glasgow Iron Co., at Pottstown, Pa., have authorized their executive committee to take steps looking to the removal of the entire plant to a point in the western part of that town lying between the Philadelphia and Reading and Pennsylvania railroads. On this site the company own twenty-three acres of ground, on which their valley mill is located, formerly known as the Glasgow Steel Works.

One of the most elegant trade publications noticed of late is that of the Jones & Lamson Machine Company, of Springfield, Vt. It is called "*Rapid Lathe Work, New Method*," and is devoted to an illustrated description of their new "Turntable Turret Lathe," illustrated in our issue of May 7, the same engravings being used, in addition to which there is a folded sheet of full size engravings of specimens of the work done on the machines these being especially interesting to any one accustomed to screw machine or lathe work. It will be sent to any interested reader of this paper upon application.

Petroleum as a Fuel.

The Oroya Railroad, and the Mollendo, Arequipa, and Puno Railroad, of Peru, have decided to use fuel oil instead of coal. This oil is not "crude" petroleum, but is a residuum oil with a fire test of about 300 degrees Fahr. Already several locomotives are running with the new fuel on the Oroya Railroad, whilst the southern road has begun to alter her locomotives. The following data is taken from *Engineering*, London. Since the month of March, 1890, careful experiments have taken place on the Oroya line to test the comparative efficacy of oil and coal in locomotives. These trials were inaugurated by Mr. Herbert Tweddle, Jr., resident manager of the London Pacific Petroleum Company, when in Lima, and he altered the first locomotive for burning fuel oil.

On April 30th, 1890, the first regular passenger train in South America, pulled by an oil-burning locomotive, was hauled up to Verrugas, 5,800 feet above the sea level, arriving on schedule time. From this time until September, when the fuel was definitely approved of, an engine ran regularly on the mountain service without a breakdown. Against her was run a sister locomotive burning coal, running for five months alternately, pulling equal trains over exactly the same ground; and it is believed that these trials furnish the best competitive tests of practical oil and coal burning on a railroad.

Engine No. 1 ran with coal, engine No. 15 with fuel oil. Both engines were exactly alike in other respects. These engines are of the Mogul type, built by the Roger Locomotive Works, of Paterson, N. J. Driving wheels, 47 inches in diameter; cylinders, 18x24 inches; total weight of engine, 38 tons; tender, 28 tons. Regular train, 5 cars; average weight of car, 18 tons gross. Total weight of train, including tender, 118 tons. Eight and ten cars are sometimes taken as far as Chosica, from where three and four per cent. grades begin. The present terminus of the Oroya is Chicla, 12,218 feet above the sea, and distant from Callao 86 miles. From Chicla to the summit tunnel is about 20 miles. The summit tunnel is situated at 15,720 feet. This is the highest railway mountain pass in the world. The grades and distances as far as Verrugas are as follows:

Stations.	Distance from Callao in Miles.	Height above Sea Level.	Average Grade.
Callao	0	0	
Lima	8½	448 feet	1 in 100
Santa Clara	18¾	1312 "	1 " 60
Chosica	33½	2832 "	1 " 53
San Bartolemé	47	4919 "	1 " 84
Verrugas Bridge	51¾	5840 "	1 " 27

Amongst heavy grades as far as Verrugas, may be mentioned: Between Chosica and San Bartolemé one grade, 4.2 per cent.; another 4 per cent., combined with a curve of about 898 feet radius; again a grade of 3.92 per cent., combined with a curve of about 370 feet radius.

The steam gauge on engine No. 15 always recorded from 135 to 140 pounds, never falling below 135 pounds. As a rule, the hand stood immovable at exactly 140 pounds, and although the safety valve would blow off at 142 pounds, so admirably was the fire at all times under control, that it very rarely blew off. On all the grades up to 3 per cent. no smoke showed from the stack. On the 4 per cent. grades a slight hazy smoke would show at times.

The average consumption of coal for the month was 79.30 pounds per train mile. The average consumption of fuel oil per

train mile was 38.55 pounds, or slightly less than 50 per cent. of the amount of coal used. In the tunnels, the oil proves a great boon to passengers, doing away with the former choking smoke, whilst at all times windows may be kept wide open, with no danger of sparks or red-hot pieces of coal flying in.

No alterations are made to the fire-box for the use of this oil as fuel, and but few additions are put to the regular ash-pan. The back damper is completely closed, and a large front damper, with about 2 square feet superficial opening, is arranged in front. A plate is placed on top of the ash-pan, extending from the front of the fire box to about the center of the ash-pan. Air is admitted into the furnace through an opening 20 inches by 14 inches, cut through the plate near the center of the pan. This plate supports the fire brick at the front of the fire box, which receives the vaporized oil. These fire bricks are built up to a height of about 2 feet, and the whole is surmounted by a brick arch extending to within 18 inches of the back end of furnace. On the sides of the furnace the brick work extends 2 inches above the mud ring. Only 150 bricks are used for the whole brick work, including the arch. This brick work will last from six to eight months.

The burner is attached to the bottom of the fire-box at the back end. The construction of the burner is extremely simple; it is a cast-iron rectangular box divided lengthways into two compartments, one above the other. The upper one is the oil passage; the lower one, the steam passage; both these passages are 3 inches wide by $\frac{3}{4}$ inch deep. The oil passage is tapped at the rear end for $1\frac{1}{4}$-inch oil pipe, and the steam passage is tapped for a $\frac{1}{2}$-inch steam pipe. The aperture for the oil passage is 3 inches by $\frac{3}{4}$ inch; the steam aperture is $3\frac{1}{4}$ inches by $\frac{1}{40}$ inch. The oil coming through its passage falls directly on the steam shooting through the narrow slit at the end, and is completely vaporized. With this burner, the bricks do not serve in any way for breaking up the oil, but merely as a white-hot retort, in which air and vaporized oil are mixed in the proper proportions. The supply of air is regulated by the front damper, the supply of oil by a gate valve worked by a wheel under the fireman's hand in the cab. The steam is never touched excepting when the engine is laying up for any length of time at the station. The fuel and air are under complete control of the fireman, whereby a perfect combustion with no smoke is obtained. The burner is in one piece, without any movable parts, and cannot get out of order.

Steam from another locomotive is used in getting up steam; 100 pounds from cold water has been shown on the steam gauge in twenty-five minutes, but an hour is generally taken, so as not to strain the boiler. Wood can be used for getting up steam if necessary. No. 15, after running six months, showed no signs of leaking in the fire-box, nor any other signs of straining. The results of these practical tests are considered very satisfactory, and, as a consequence, everybody in Peru at present is said to be convinced that petroleum is the ideal fuel—the fuel of the future.

It is stated that Congress has been induced, through the efforts of ex-senator Farwell, to appropriate $9,000 to be used in making experiments in producing rain. Balloons are to be charged with an explosive mixture of oxygen and hydrogen, and exploded at a considerable elevation by means of a wire and an electric battery, and simultaneous explosions of charges of dynamite are to be made on the ground. These tests will be tried in Western Kansas, under the direction of Col. Dyrenfurth.

In recognition of the value of his work in writing the book, "Metallurgy of Steel," noticed in our issue of August 21, 1890, Mr. Henry Marion Howe has been awarded a prize of 2,500 francs by the Societé d'Encouragement pour l' Industrie Nationale, of Paris.

Uncle Ben's Letters.

No. 5.

Dear Tom:

I was very glad to get your letter, and to learn that you are fairly installed as superintendent of the Eagle Iron Works. So far, so good, and I am glad you feel encouraged, and will not say one word to dishearten you.

You say the concern has a large jobbing and repair trade among country mill owners, etc. This is the best school in the world for you; if you can manage this well, you can do anything. To do this, you must make the customers like you, and trust in you. And the way to a customer's heart lies directly through his pockets. To make him feel satisfied, you must always try to show him that he has got his money's worth.

Never put anybody but a spry, active fellow at any floor or bench work for a customer; and for the machine tool part of the job, give him a careful man, who knows how to hustle. Many jobs do not show, when done, how much work has been put upon them; and most customers have little idea how much time some kinds of work require You must therefore try, by all means, when you charge a customer with ten hours' time, to give him something that looks like a day's work. See that no time is wasted; and don't let the first hour of every job represent time spent in the blacksmith shop, waiting for lathe tools, or looking all over the place for blocking or planer bolts.

Allow no one in the office to take up the record of the men's time, and turn in bills to customers, without your knowledge. This is sure death to business; yet in many shops it is always done. You are the only proper judge of what a customer should pay, and you need no bookkeeper's disastrous assistance. You know old man Hopkins oughtn't to be charged full time for cutting those ten bolts in the lathe, as you had to do, because the only one-inch dies for the bolt cutter had just been broken, and the old fellow was in a hurry. Nor can you ask that other man to pay for five and a half hours for boring that little pinion, because the lathe countershaft had to be taken down and fixed, in the middle of the job. And yet you will find that if the time cards, or whatever they use, don't go through your hands, lots of such things will pass through the office, and will make a very mortifying, though undeserved, record for you.

Never do a poor job, even if your best customer demands it. "There, there; that's plenty good enough; I don't want to spend much money on it. Anything 'll do for that, you know." Yes, I know; when he finds the thing won't work, or don't last, just as you told him, and he comes to realize that the thing must be better done, then how he will cart your "botch job" to another shop, "where they know how to do it right." And when he gets there with it, he'll show you and your botch job up, in great shape. He'll do it, every time.

* * * * * * *

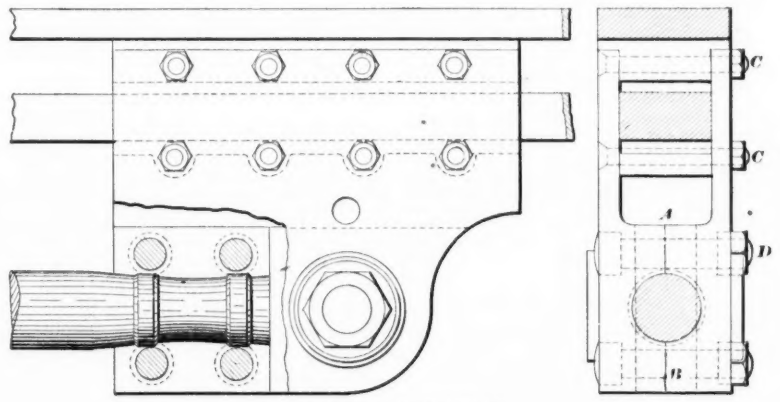
Your concern seems to be doing a fine business in portable engines and boilers, and I know they have several good traveling men out, pretty constantly. You must make it your business to confer fully and freely with these men. They hear all the complaints and criticisms, and are better acquainted with competing goods than you can possibly be, or any one else about the place. And they will tell you lots of things that they wouldn't tell in the office, because you are a new man, and not responsible for the work of Mr. Dunn, the old foreman, which they are selling now.

And, Tom, besides all that you can learn from the agents, you must keep fully abreast of the times. Insist upon traveling any moderate distance, whenever necessary, to see and study every new article in your line of manufacture. This is a measure of self-defense; for, if you let them keep you shut up forever in the shop, where you can get no new ideas, the company will finally come to regard you as being behind the times, and to discredit your opinions as those of an old fogy; forgetting that they themselves have denied you all chance of being anything else.

UNCLE BEN.

Locomotive Crosshead.

The accompanying illustration represents a new design of a locomotive crosshead for which a patent has recently been granted to Mr. W. S. Hughes, of 237 East 73d street, New York. It is made in two pieces; the joint is at *A B;* the parts are bolted together by the bolts *D D*, which also firmly clamp the piston rod to the crosshead. This end of the piston rod is tapered from each end of the hub towards the center, the smallest diameter being at the center. In order to obtain further security two collars are formed on this end; the shoulders of these collars are not turned square to the axis, they are turned slanting, so that in tightening up the bolts *D D* all possible end play will be prevented. These collars are also admirably adapted for resisting the end thrust without throwing any extra strain on the crosshead or bolts *D D*. It will be noticed that no key is used for securing piston rod to crosshead, therefore this end is much stronger than that of the ordinary design, and all danger of injury to the crosshead by driving a key is avoided. The piston rod has no shoulder bearing against the hub of crosshead, and therefore the liability of breaking the rod is much reduced. The taper on the end of the rod extends a little beyond the hub, which allows the rod to be trued up without reducing its diameter to such an extent as to make it smaller than that of the end. It must be readily perceived that a wrought-iron crosshead of this design can be made much cheaper than a solid one of the same form and material, and on the whole, it is much stronger. Brass liners can readily be introduced between the wings and the slides, and held in position by the bolts *C C*, so as to prevent heating and cutting on the sides of the slides.



LOCOMOTIVE CROSSHEAD.

Some of these crossheads have been in constant use for several months, and have worked very satisfactorily; a further and more extended use will undoubtedly increase the appreciation of its good features.

It is stated that the British Consul-General at Hamburg, in a report to his government, predicts that the day is not far distant when the German coal market will be lost to the British coal trade, as the German coal industry is one which is each year assuming larger proportions.

English technical journals are publishing Mr. D. A. Wightman's statement to the effect that the first compound locomotive was built in America, by the Remington Company, at Ilion, N. Y. It was built in 1870, and was for suburban traffic. It had cylinders five and eight inches diameter, and twelve inches stroke. The boiler had a superheating attachment by which heat was imparted to the steam in its passage from the high to the low-pressure cylinder. It had, also, means for changing from compound to simple working. This engine is said to have been working till within a short time.

It is expected that next winter a system of steam heating will be in use on the Wurtemberg (Germany) State Railroads. An appropriation of about $18,500 has been made for that purpose.

Machinists' Supplies and Iron.

NEW YORK, June 20, 1891.

Iron—American Pig—The market is steady and demand fair.

We quote: No. 1 Foundry, Standard Northern brands, $17 to $18; No. 2 is selling at $16 to $17, and Gray Forge at $13.90 to $14.50. Southern brands of good quality are obtainable at $16 to $17 50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $24 50 for Coltness; $22 for Dalmellington; and $20.50 for Eglington.

Copper—The market for Lake copper has not improved. There are bids at 12¾ cents, with liberal offerings at 13 cents on spot, and 13⅛c. to 13¼c. for future. No fresh business is reported.

Lead—The market is easier and nominal at 4.35c. to 4.40c. Very little interest is manifested by buyers. There is no indication of business in any quarter.

Spelter—The current quotations are 5c. for Westerns hipments of best brands, New York delivery. The inquiry is reported better, but actual business is light.

Tin—The market is dull and prices are about the same as in our last report, the bidding and asking figures being 20 50c. to 20.70c. for spot. No fresh business is reported.

Antimony—The local market is unsettled.

We quote Hallett's at 13¼c. to 13½c.; Cookson's, 14½c. to 15c.; and 14c. for X. L.

Lard Oil—The market is firmer at 52c to 53c. for Prime City, according to holder and quantity. Western on spot is quoted at 51c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Several first-class pattern makers. Address "E.," care of AMERICAN MACHINIST.

Wanted—A position as foundry foreman or superintendent. Particulars given on application. Address Box 5, AMERICAN MACHINIST.

First-class mechanical draftsman and machinist (graduate Europe) wants responsible position. Address S., AMERICAN MACHINIST.

Wanted—First-class pattern maker on small machine patterns; must be quick, sober and reliable. Blake & Johnson, Waterbury, Conn.

Wanted—Situation by a technical graduate who has had 8 years of practical experience; age 25. Address D. E., AMERICAN MACHINIST.

A first-class tool maker, well posted on automatic machines, wants situation to keep them in order, or to build new ones. Address Box 9, AM. MACHINIST.

A mechanical draftsman, thoroughly competent in engine and machine designing, desires engagement. Address BOX 8, AMERICAN MACHINIST.

First-class designer of machine tools and special machinery open to engagement after July 1st. H. M., AMERICAN MACHINIST.

Wanted—First-class mechanical draftsman; apply, stating experience, and wages expected, to Edison General Electric Co., Canadian Works, Peterborough, Canada.

Foreman machinist, to take charge of 20 to 50 men; principal work, marine engines. State age, experience, nativity, and salary expected. Address Marine, AMERICAN MACHINIST.

Several mechanical draftsmen wanted in consulting engineer's office; only those with good experience in drafting-room and shop need apply; good positions for first-class men. Address, stating particulars, P. O. Box No. 2108, Boston, Mass.

Wanted—By an experienced mechanic and draftsman, a position as designer of high-speed, high-power machinery for yachts, launches, etc. (along the Lakes preferred); expert in handling men; free after July 1st. BOX 7, AM. MACHINIST.

Wanted—At Pittsburgh Locomotive Works, Pittsburgh, Pa., a competent foundryman to take charge of iron and brass foundries; must be active, entirely temperate, and thoroughly understand locomotive work; state salary expected, and give references.

Wanted—A sober, energetic young man, good engineer and machinist, who can operate a Miller & Bierce steam and hydraulic cotton compress successfully; also take charge of labor around the compress, commencing August 15th inst.; salary $75 per month. Address, with references, Union Compress & Warehouse Co., Macon, Ga.

A sober, steady foundry foreman, 11 years' experience as foreman on engine, saw-mill and jobbing work, wants position as foreman; up in cupola practice. Steady, AMERICAN MACHINIST.

Wanted—Tool maker for making and tempering threading dies for turret screw machines; only those whose experience guarantees successful and uniform results need apply. State experience, wages, etc.; no time wasted in correspondence. Niagara Screw Co., Buffalo, N. Y.

Type-writer manufacturers, or parties making fine, light interchangeable machines, who desire the assistance of a tool designer and maker, send for simple drawings of special tools and fixtures; experienced as foreman, and in the systematizing of manufacture. Address Box 10, AM. MACHINIST.

Wanted—A thoroughly competent man for superintendent of a manufacturing concern in Chicago, employing about one hundred men; must be experienced in manufacturing high grade machinery, tools and hardware specialties, in large quantities on an economical basis; good position to the right man. Box 3, AMERICAN MACHINIST.

Wanted—Position as supt. or foreman, by a young man, 36, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men; a designer and draftsman of automatic and interchangeable machinery, tools, jigs, etc. W. H. S., Box 197, Burnside, Conn.

Wanted—By a western technical school, an instructor in pattern making and wood work, one capable of organizing and directing a systematic course of training; also a brass molder thoroughly posted in the various branches of foundry practice, and capable of giving instruction in same. Address, with references, A. W. Bradley, AM. MACHINIST.

Situation Wanted—A foundry foreman of several years' exp. in a couple of the best shops in the U. S., and capable of handling men to an advantage, and taking charge of the most difficult work in either loam, dry or green sand, will be open for an engagement after July 1st. Best of references furnished. Address Box 4, AMERICAN MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Bowsher's Balancing Ways. See adv., page 17.

Auto. Steam Flue Cleaners Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Engine for sale; 55 H. P. Watts-Campbell slide valve engine in good order; will be sold cheap. F. Berg & Co., Orange Valley, N. J.

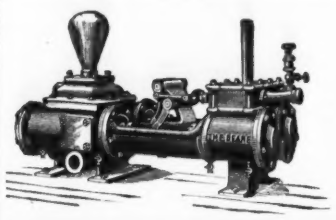
One Wright automatic engine for sale, in good condition; cylinders 15"x32". Can be seen at 251 Greenpoint avenue, Brooklyn.

Wanted—Agents for Mechanics' Reference Book of Practical Rules and Tables. All mechanics should send 15 cents for this book. Address Summit Pub. Co., Akron, O., Box 40.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted—Wm. Rontree, engineer, who was employed in our works during 1886 and 1887, will hear of something to his advantage by addressing us at once. Any information of the above will be thankfully received at the Fulton Iron Works, Second and Carr streets, St. Louis, Mo.

Partner Wanted—A party owning the entire business of a manufacturing establishment in Chicago employing about 100 men and manufacturing articles thoroughly established and known to be among the best selling in their lines, desires to associate himself with a gentleman with sufficient means to take an equal interest in the business. A party acquainted with manufacturing preferred; references required and given. For particulars address Box 6, care AMERICAN MACHINIST.



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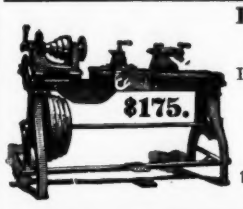
MAKERS OF FINE STEEL
For Dies, Punches, Taps, Reamers, Cold Chisels, Lathe Tools, Shear Blades, Milling Cutters, Etc., Etc.



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Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
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All Kinds in Stock. Gold Medal, Paris, 1889.
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VERTICAL SPINDLE MILLING MACHINE.

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FOR SALE by order of the Trustees under the will of the late Jonathan Bourne, the large and well appointed Machine and Foundry Buildings, located at New Bedford, together with about 70 rods of land. The Machine Shop is a three story stone building 100x50 ft., gravel roof, strongly built and well lighted, in full operation and can be seen. It contains one 45 H.P. steam engine, together with all the machinery and tools to be found in a first class Machine Shop. The Stone Foundry is 90x65 ft., gravel roof, and is connected with the Machine Shop by a covered passage way. No better chance than the above is offered to parties seeking an opportunity to engage in the Machinery, Pattern or Foundry business in a live and rapidly growing City like New Bedford, that now ranks third as a cotton manufacturing center. For further particulars apply to
WILLIAM A. ABBE, Trustee, Or STANDISH BOURNE, New Bedford, Mass.

PATENTS for inventions procured. Litigation, Searches, Opinions, &c. Trade Marks, Labels, &c., registered.
J. NOTA McGILL, Attorney-at-Law, ATLANTIC BUILDING, WASHINGTON, D. C.

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We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
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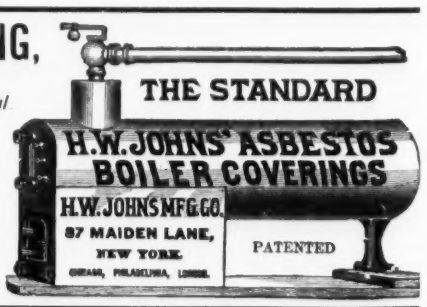
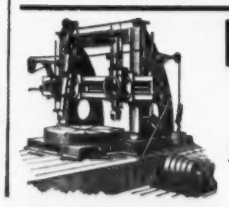
87 Maiden Lane, NEW YORK.

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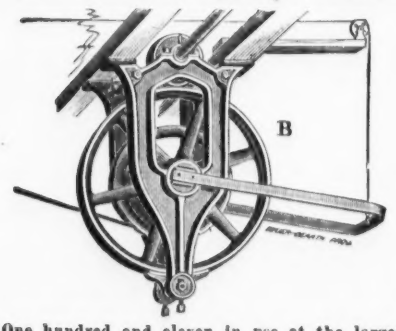

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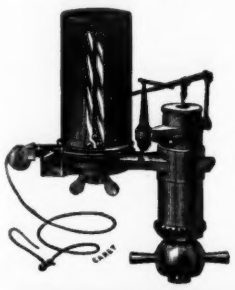

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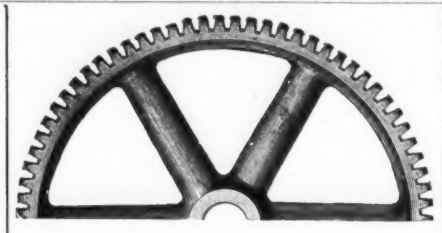

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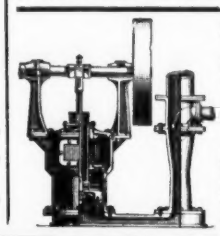

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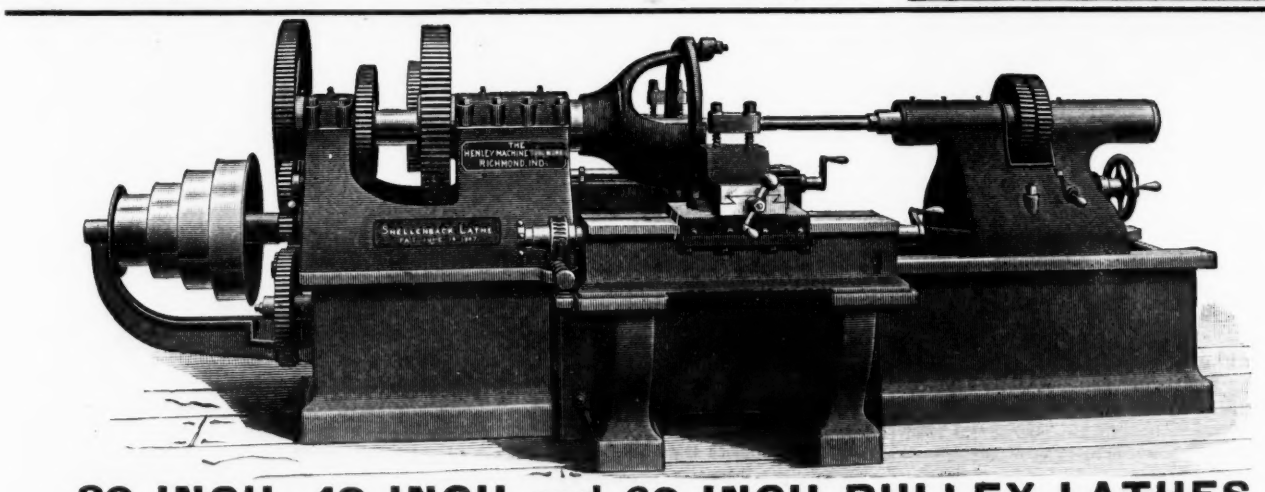

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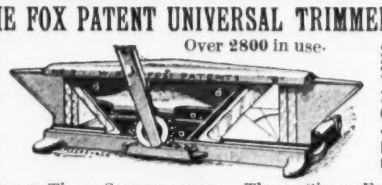

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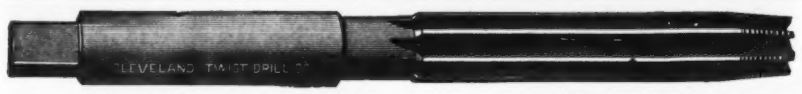

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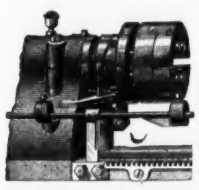

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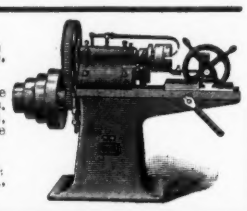

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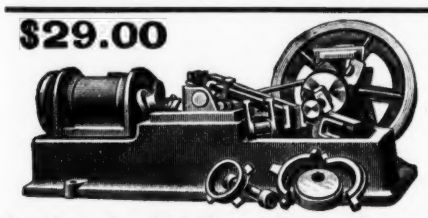

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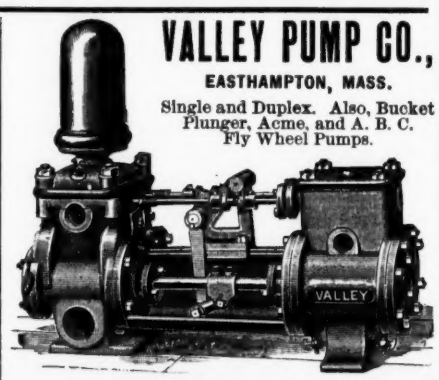

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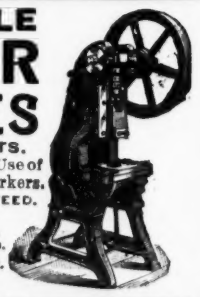

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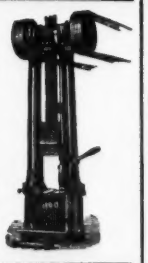

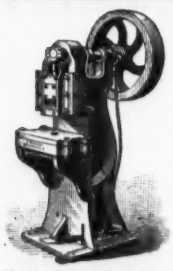

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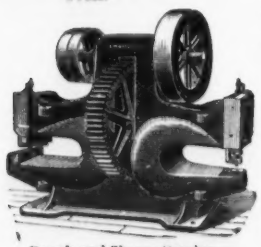

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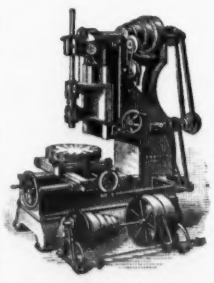

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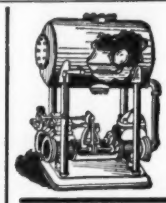

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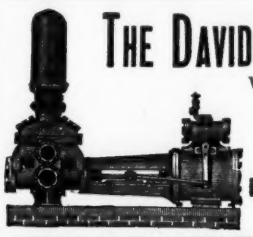

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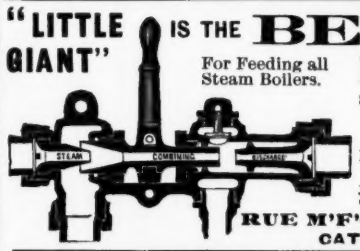

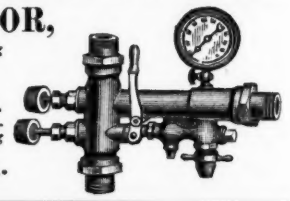

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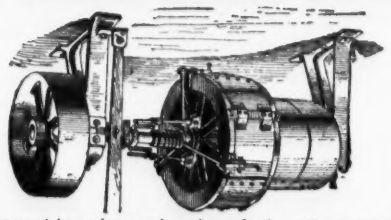

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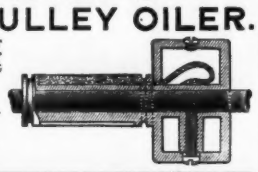

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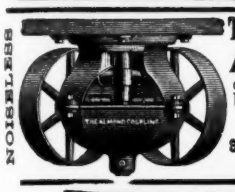

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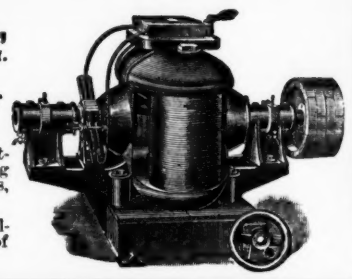

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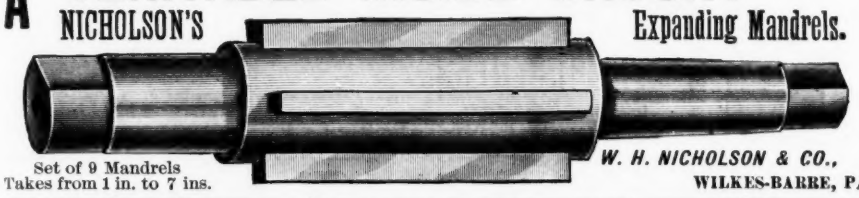

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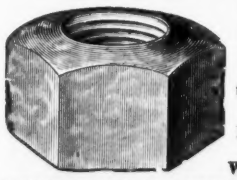

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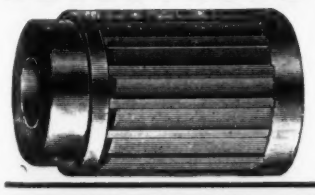

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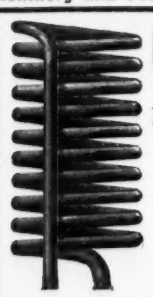

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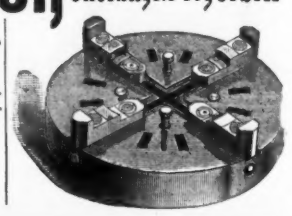

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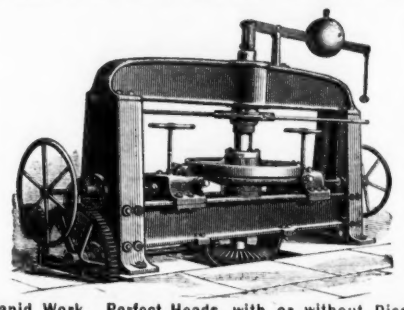

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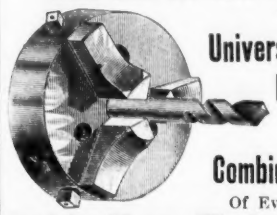

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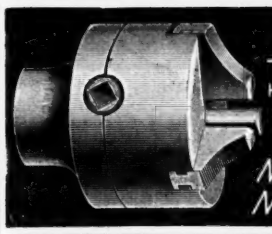

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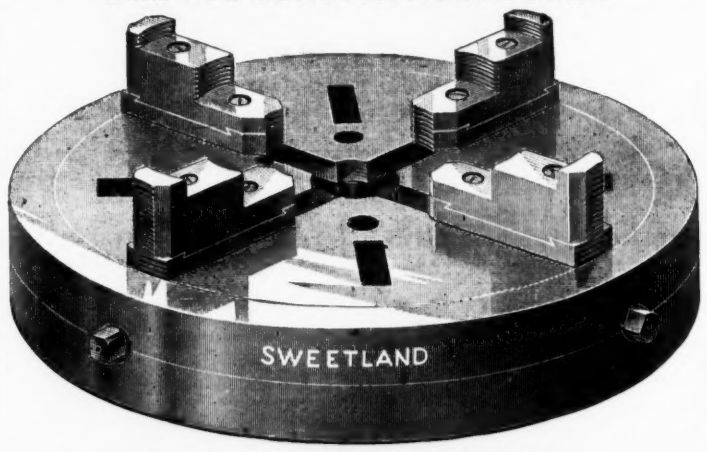

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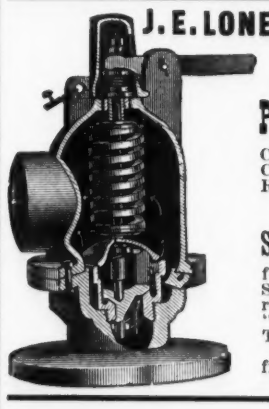

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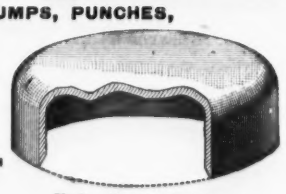

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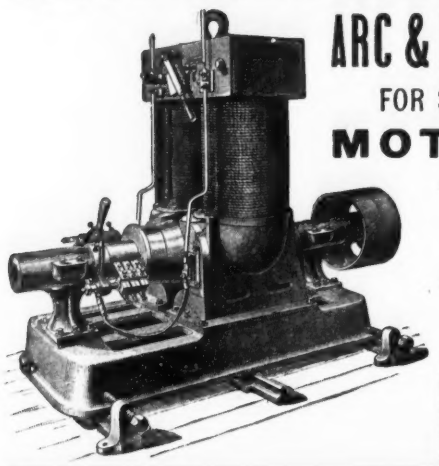

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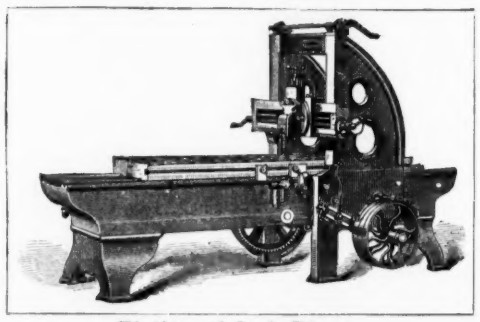

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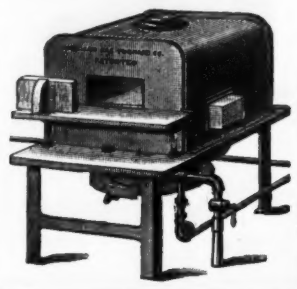

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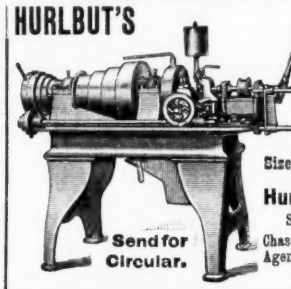

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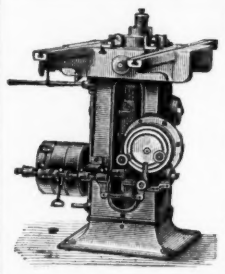

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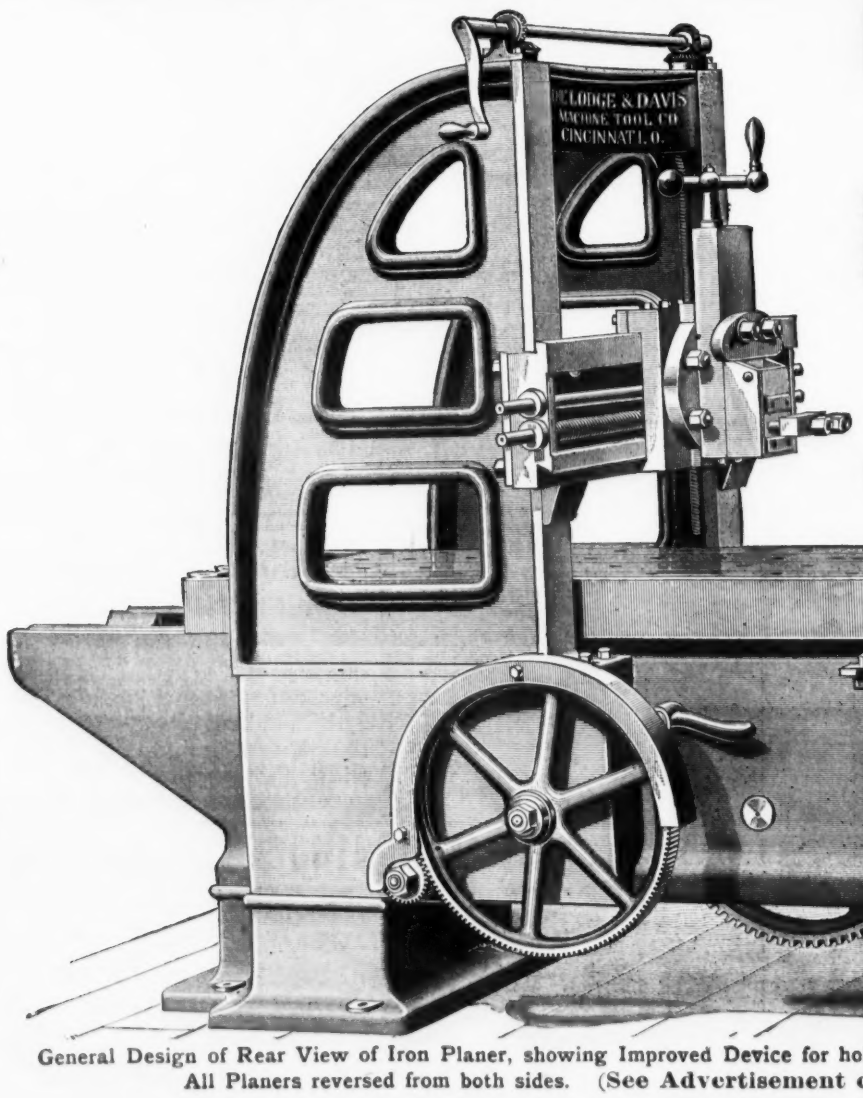

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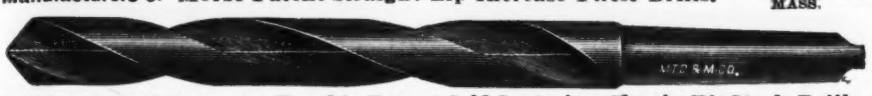

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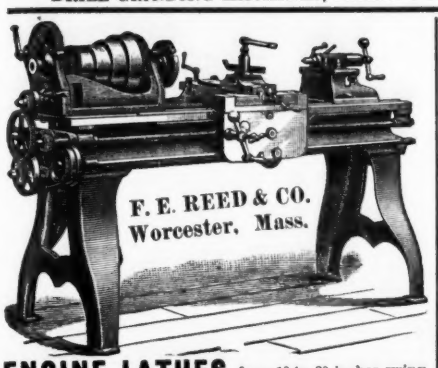

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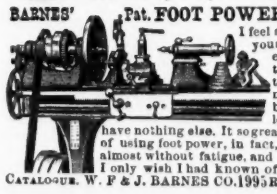

I feel so highly pleased with your Velocipede Foot Power with seat, that I wish to add my testimony to its superiority. I did not expect to like it, but having used the Velocipede Power I would have nothing else. It so greatly lessens the fatigue of using foot power, in fact, it may be said to be almost without fatigue, and is a steadier motion. I only wish I had known of it sooner. SEND FOR CATALOGUE. W. F & J. BARNES CO. 1995 Ruby St., Rockford, Ill.

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A new idea. A time saver. A tool to take the place of the devices in present use for balancing pulleys, armatures, cutter heads and rotary parts of machinery in general. Substantial. Accurate. Send for circular.
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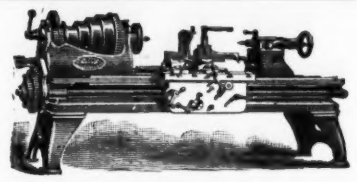

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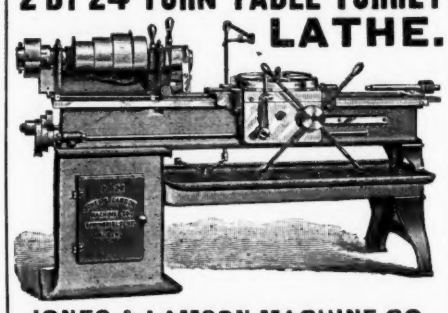

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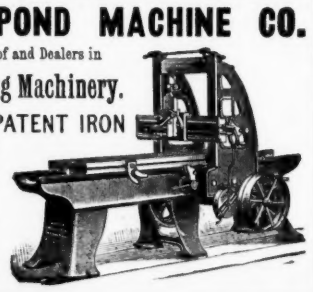

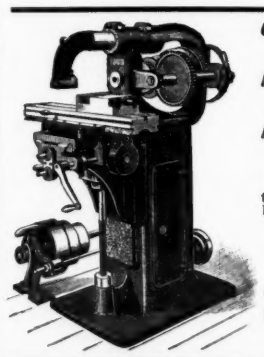

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Plain Back Geared Milling Machines.
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Drilling Machines,
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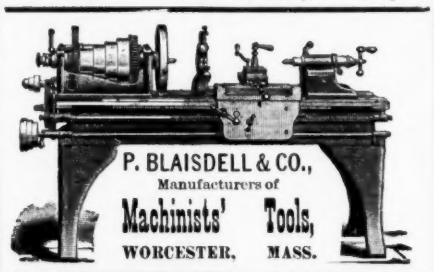

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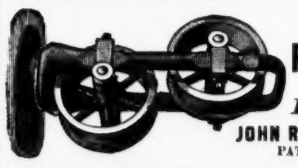

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Work and traverse instantly varied to any speed between extremes. Reversing points varied by hand. Pivoted table simultaneously clamped at both ends by hand, has no slot or screws on its end; easy to keep clean; is graduated in ¼ degrees and in taper in inches per foot.
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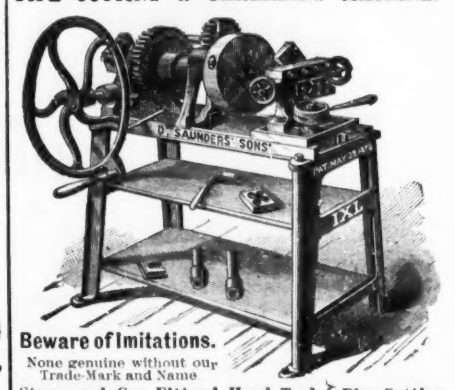

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None genuine without our Trade-Mark and Name
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SEND FOR CIRCULAR.
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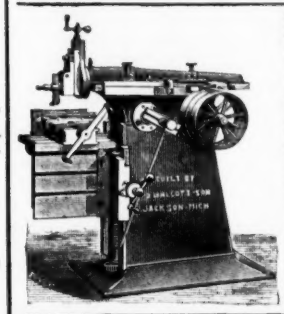

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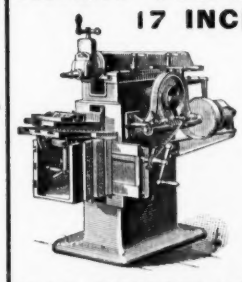

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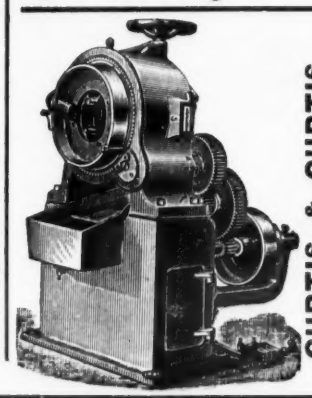

CURTIS & CURTIS,
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Pipe Cutting & Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

NEW SHOP. PERFECT EQUIPMENT. NO MAKESHIFTS.

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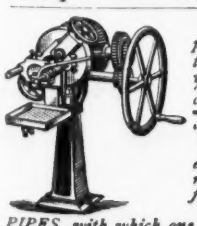
"Eclipse" Hand Pipe-Cutting Machines.



No. 1.—Powerful, inexpensive, simple in construction. Cuts and screws pipes ⅛ to 2-inch. Easily carried about.

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It will pay you to write us for particulars.

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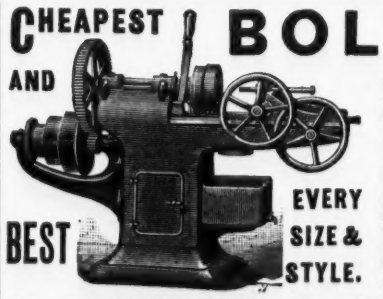

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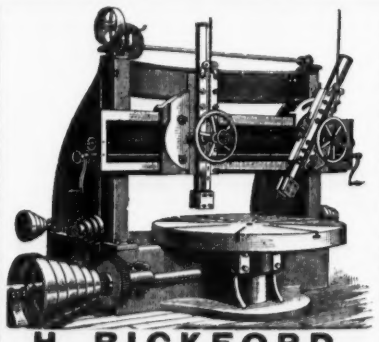

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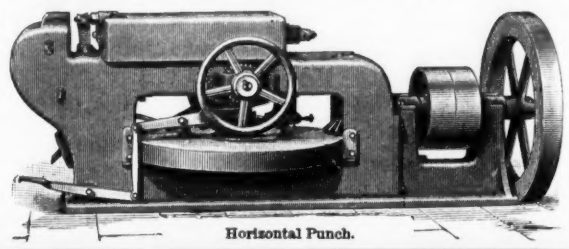
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GUARANTEED
Equal to any Planer of the ordinary style in the performance of standard size work and in
EFFICIENCY, CAPACITY, AND ADAPTABILITY TO EXCEL
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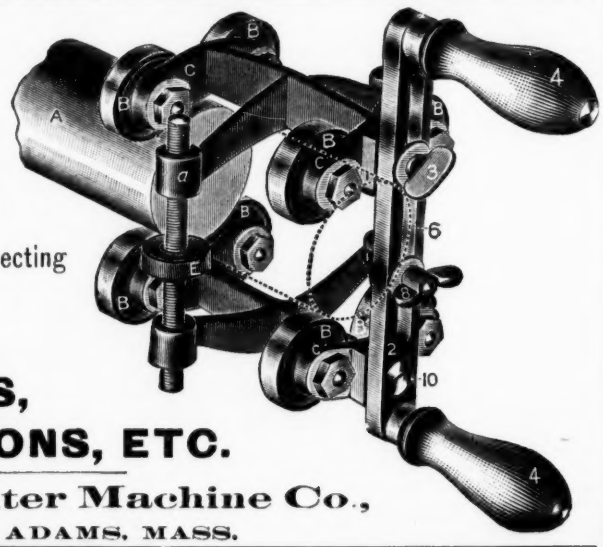

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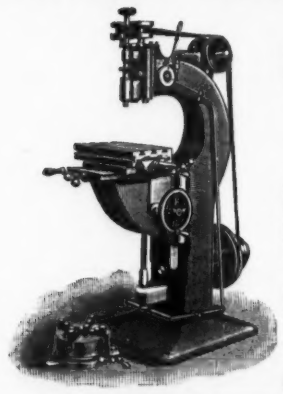

For High Speed Milling.
An indispensable Tool in any well appointed machine shop.
Speeds from 240 to 10,000 revs.
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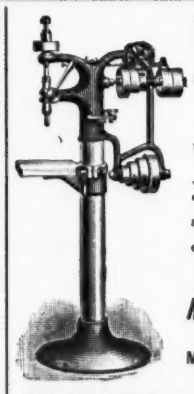

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The *Latest* and *Best*: most convenient, sensitive and durable Drill on the market.
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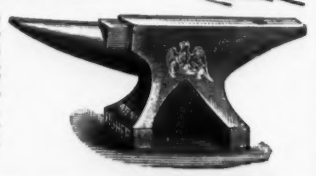

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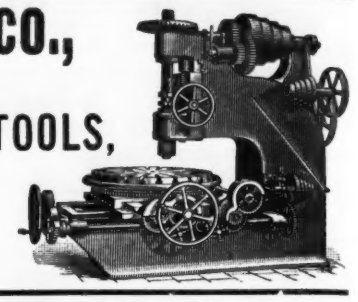

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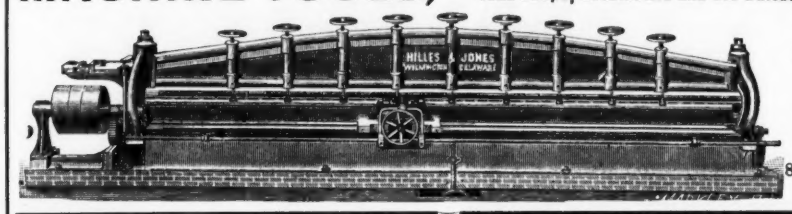

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Eight Sizes.
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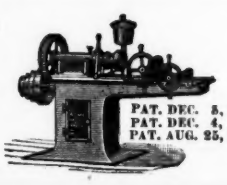
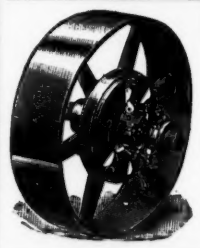

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.



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Friction Clutches
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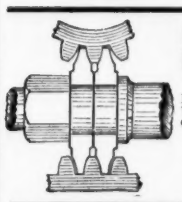

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Straight Line Centrifugal Separator.

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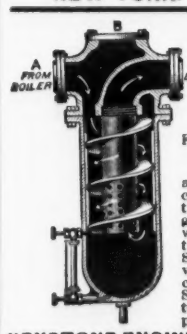

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Simpson's Centrifugal Separator and Trap.
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
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Special Radials for Bridge Builders.
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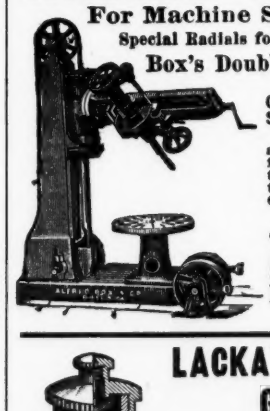

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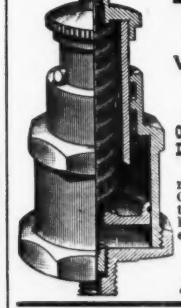

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Will Save its Cost in Oil alone Several Times per Annum.
SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.
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OUR NEW **CATALOGUE OF TOOLS**
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In Use, Over 2,500.

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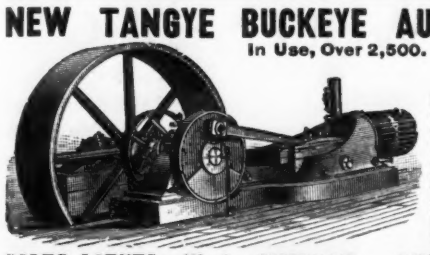

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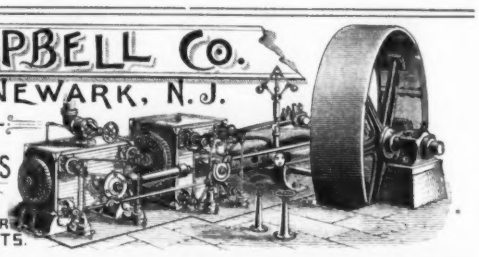

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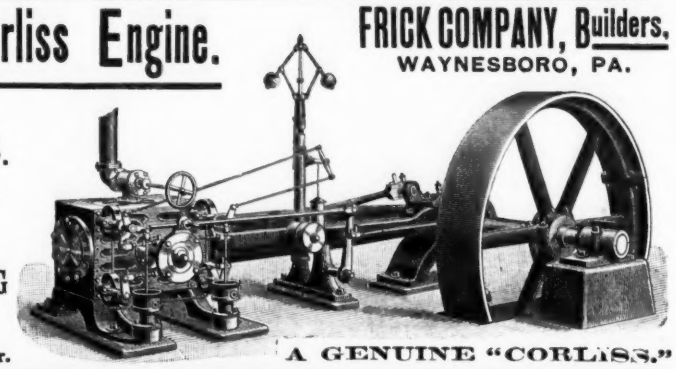

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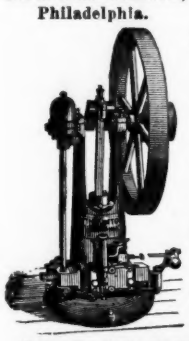

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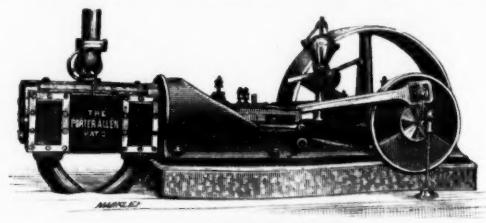

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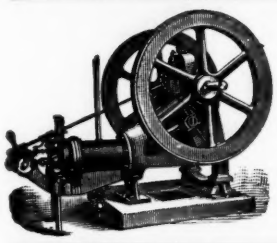

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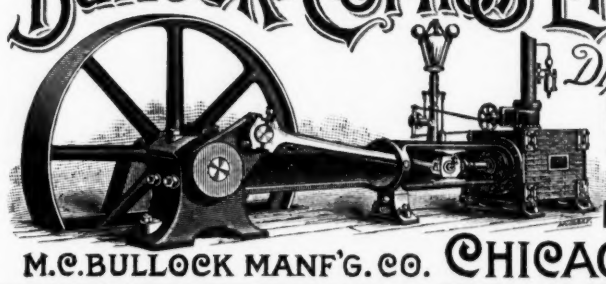

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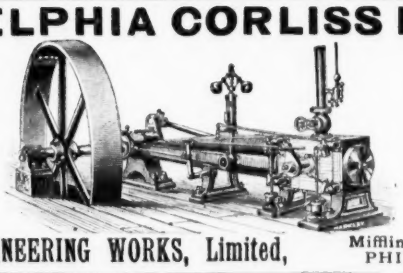

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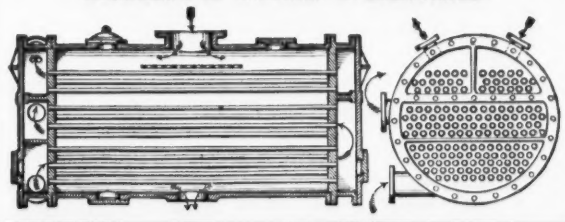

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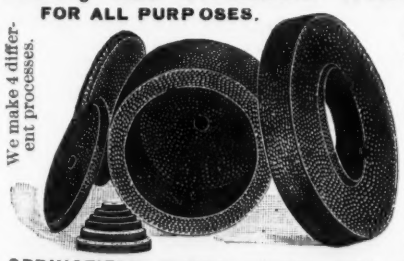

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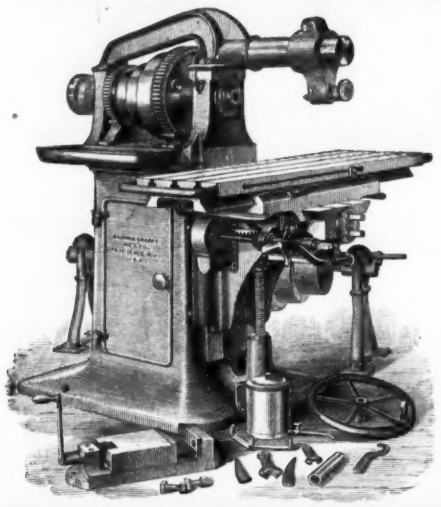

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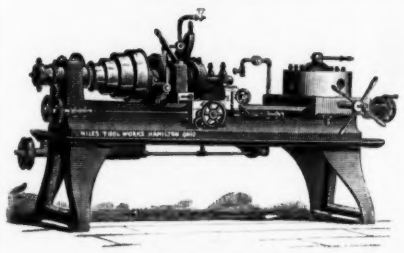

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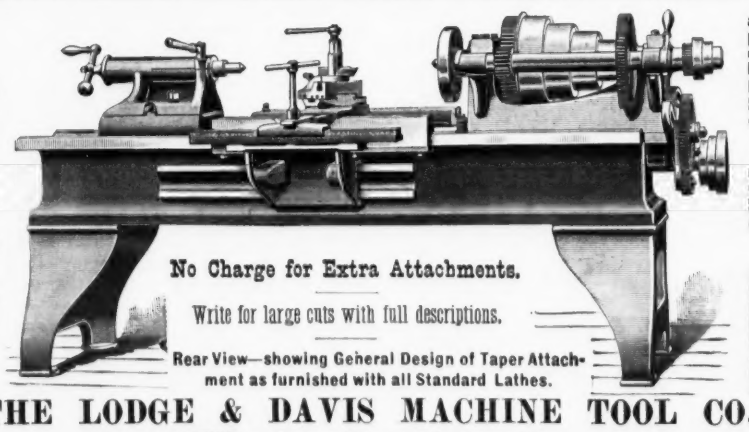

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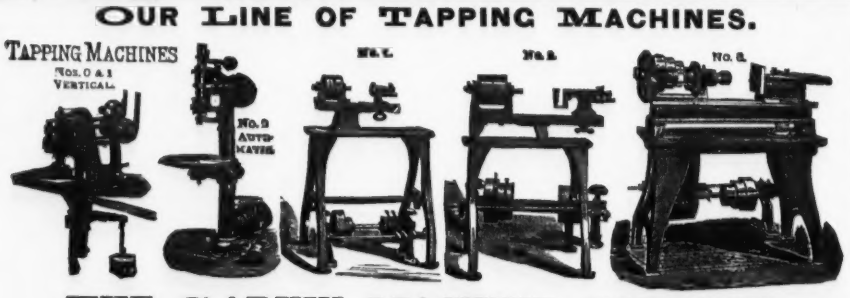

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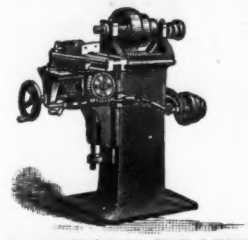

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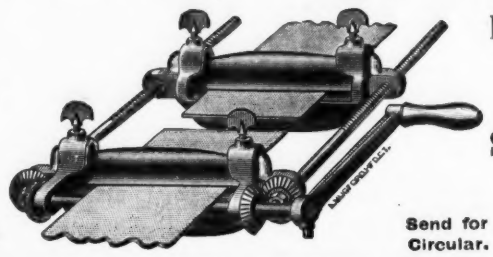

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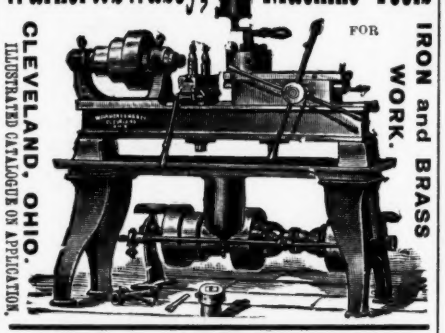

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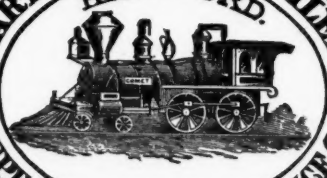

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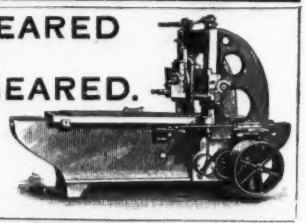

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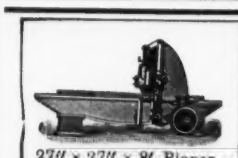

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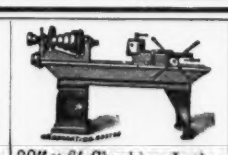

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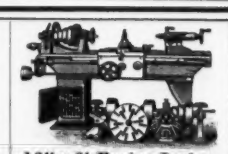

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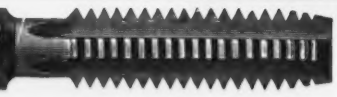

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